

حمل الآن

مجاناً وحصرياً

المراجعة رقم (1)

اختبار شهر نوفمبر



► Newton's third law

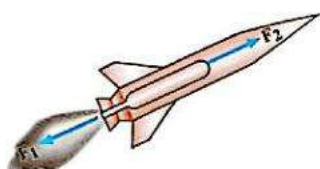
- 48 A student carries a ball in her hand, if the force that acts on the ball by the Earth is the action force, so the reaction force is the force that acts on
- (a) the Earth by the ball (b) the hand by the ball
(c) the ball by the hand (d) the hand by the Earth
- 49 * In which of the following figures the two forces of equal magnitudes F_1 and F_2 may cause equilibrium?



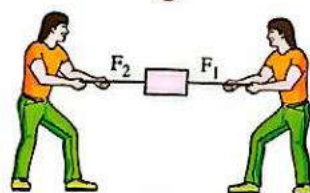
(a)



(b)



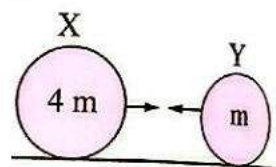
(c)



(d)

- 50 The opposite figure shows the collision of the two bodies X and Y which have masses of m and $4m$ respectively.

If body X acts on body Y during the collision by force $\vec{F}$, then body Y acts on the body X by force



- (a) $\vec{F}$ (b) $\frac{1}{4} \vec{F}$ (c) $4 \vec{F}$ (d) $-\vec{F}$

- 51 When inflating a balloon and leaving it free to release the air from it, the balloon moves

- (a) in the direction of the air rush
(b) in a direction right to the direction of the air rush
(c) in the opposite direction of the air rush
(d) in a direction left to the direction of the air rush

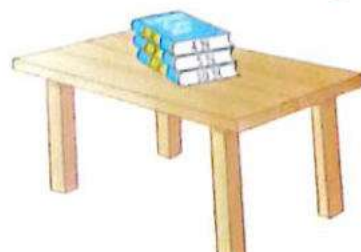
- 52 * If a body (x) acts on another body (y) by a force of 9 N, then the reaction force of body y on body x equals

- (a) 1 N (b) -9 N (c) 0 (d) 9 N

53 The opposite figure represents three books (x, y, z) of weights 4 N, 5 N, 10 N respectively, which are placed on a table, what is the value of the reaction force of book z that acts on book y?

- (a) 4 N
- (c) 9 N

- (b) 5 N
- (d) 10 N



Questions ?

Chapter 4 | Lesson 1

Answered

Density

Interactive test



First

Multiple Choice Questions

Questions signed by * are answered in detail.

- 1 Gas fluids differ from liquid fluids in that they

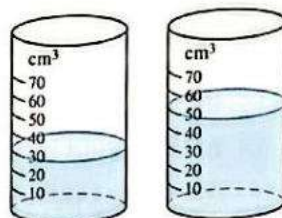
(a) are able to flow (b) are compressible
(c) have a definite volume (d) have a definite shape

- 2 From the units of measuring density

(a) N.m^{-3} (b) g.mm^{-1} (c) kg.cm^{-2} (d) g.cm^{-3}

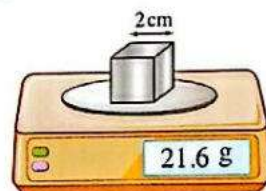
- 3 The opposite figure shows two glass beakers containing different amounts of water that has density of 1000 kg/m^3 . If these two amounts of water get added to each other while keeping the temperature constant, the final density of the water becomes

(a) 500 kg/m^3 (b) 800 kg/m^3 (c) 1000 kg/m^3 (d) 2000 kg/m^3



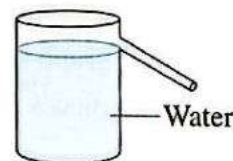
- 4 The opposite figure shows a solid cube of side length 2 cm that when it is placed on a scale, the scale shows a reading of 21.6 g, then the density of the cube material is equal to

(a) 2700 kg/m^3 (b) 3600 kg/m^3
(c) 5400 kg/m^3 (d) 10800 kg/m^3

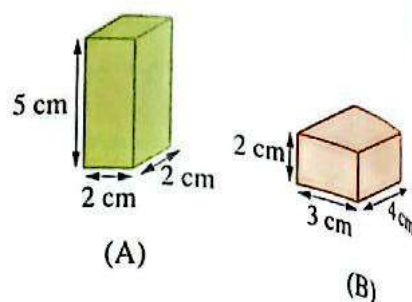


- 5 * The opposite figure illustrates a displacement can filled with water of density 1000 kg/m^3 , when a solid body of mass 1.35 g and the density of its material is 2700 kg/m^3 is immersed into the water, then the amount of water which is displaced (spilled) is equal to

(a) 0.5 cm^3 (b) 0.5 m^3
(c) 1.35 cm^3 (d) 1.35 m^3



- 6 The opposite figure illustrates the dimensions of two solid bodies A and B of equal mass, so which of the two bodies has a higher density?

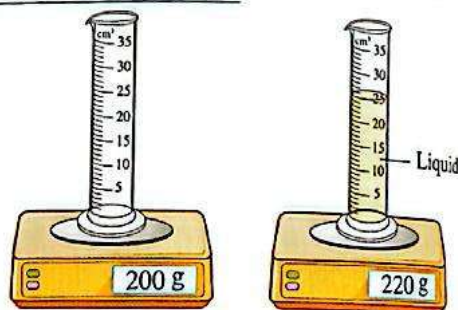


- (a) Body A
(b) Body B
(c) Both are of the same material.
(d) The answer is indeterminable.
- 7 The following table shows the specifications of two solid cubes A, B that are made of two different materials, then mass x equals

Cube	The side length (l) (m)	The density of the cube's material (ρ) (kg/m^3)	The mass (m) (kg)
A	0.01	ρ	0.008
B	0.02	2ρ	x

- (a) 0.05 kg (b) 0.09 kg (c) 0.128 kg (d) 0.145 kg
- 8 * The diagram shows an experiment to find the density of a liquid, so the density of the liquid is

- (a) 500 kg/m^3 (b) 600 kg/m^3
(c) 800 kg/m^3 (d) 1000 kg/m^3



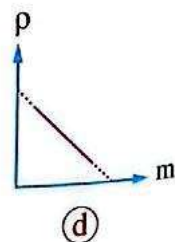
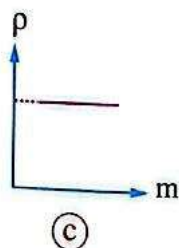
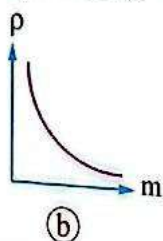
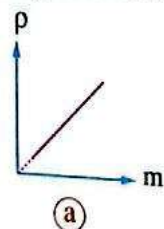
- 9 Two bodies (a, b) are made with equal masses of two different materials of densities 3000 kg/m^3 and 4000 kg/m^3 respectively, so the ratio between their volumes $\left(\frac{V_{\text{ol}}^a}{V_{\text{ol}}^b}\right)$ equals

- (a) $\frac{1}{3}$ (b) $\frac{4}{3}$ (c) $\frac{3}{4}$ (d) $\frac{1}{4}$

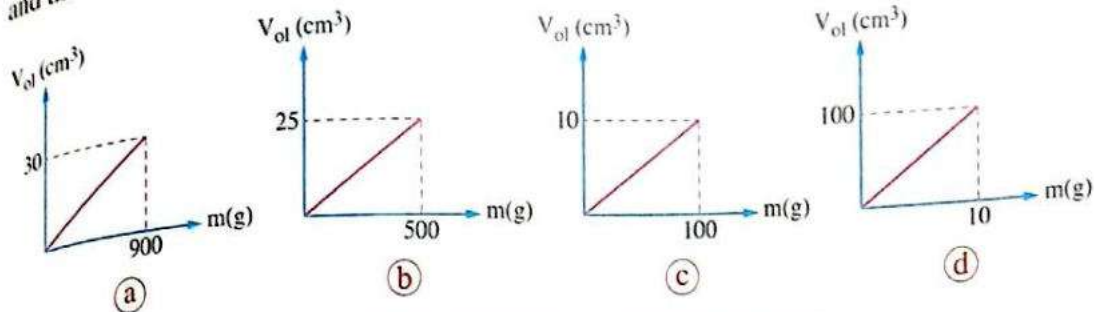
- 10 The ratio of the density of the electrolytic solution inside a car battery after discharging the battery to its density after recharging the battery is

- (a) greater than 1 (b) equal to 1 (c) less than 1 (d) indeterminable

- 11 The graph that represents the relation between the density of iron and the masses of solid iron pieces at constant temperature is

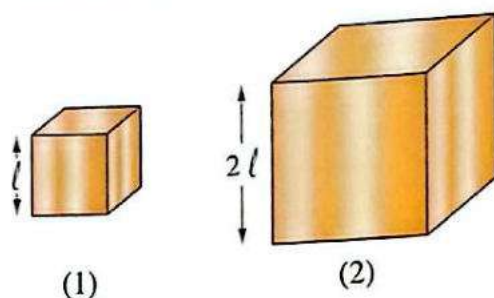


- 12 * Which of the following graphs represents the relation between the masses and the volumes of solid pieces of a metal of density 10^4 kg/m^3 ?



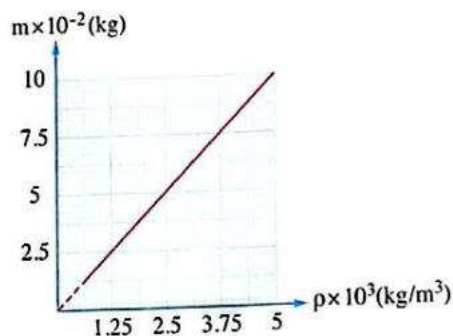
- 13 The opposite figure shows the dimensions of two solid cubes (1), (2) that are made of copper, if the mass of cube (1) is m , so the mass of cube (2) equals

- (a) $2m$ (b) $4m$
(c) $8m$ (d) $16m$



- 14 The opposite graph shows the relation between mass (m) and density (ρ) for equal volumes (V_{ol}) of different materials, so the value of this volume (V_{ol}) is

- (a) 10 cm^3 (b) 20 cm^3
(c) 30 cm^3 (d) 40 cm^3



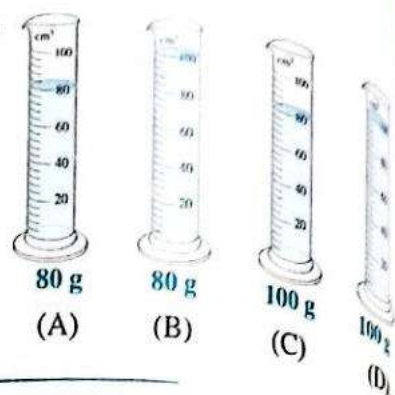
- 15 * The following table shows the densities of some substances:

Substance	Mercury	Copper	Iron	Water	Kerosene
Density (g/cm^3)	13.6	8.9	7.9	1	0.87

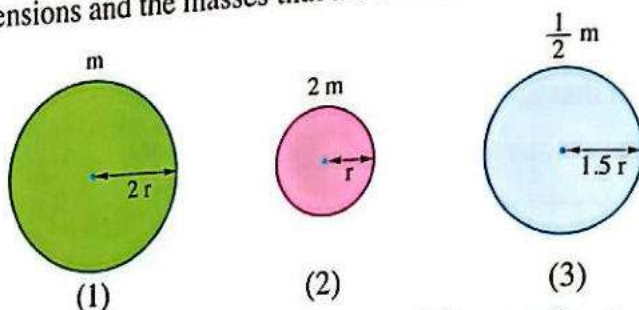
Which of the following statements is correct?

- (a) The volume of 1 g of mercury is greater than the volume of 1 g of copper.
(b) The volume of 1 g of iron is less than the volume of 1 g of copper.
(c) The mass of 1 cm^3 of mercury is greater than the mass of 1 cm^3 of any other substance in the table.
(d) The mass of 1 cm^3 of water is less than the mass of 1 cm^3 of any other substance in the table.

- 16 * The opposite figure shows four graduated cylinders, each of them contains a liquid whose mass is labelled below its cylinder. If all the cylinders are at the same temperature, so the two cylinders which contain the same liquid are



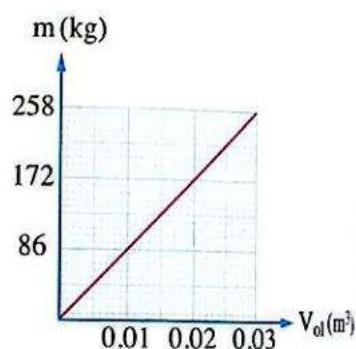
- (a) A, D
(b) B, C
(c) A, C
(d) D, B
- 17 Three solid spheres (1), (2) and (3) are made of different materials x, y and z respectively, with the dimensions and the masses that are shown in the following diagrams;



So, the correct arrangement of these three materials according to their densities will be

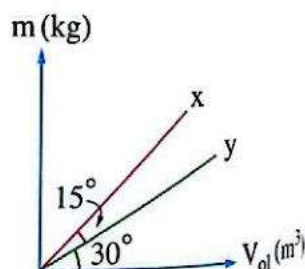
- (a) $z < y < x$
(b) $z < x < y$
(c) $x < y < z$
(d) $x < z < y$

- 18 * The opposite graph represents the relation between mass (m) and volume (V_{ol}) for several pieces of copper, so the density of copper is



- (a) 6800 kg/m^3
(b) 7800 kg/m^3
(c) 8600 kg/m^3
(d) 8700 kg/m^3

- 19 * The opposite figure represents the graphical relation between mass (m) and volume (V_{ol}) for two materials x, y, then the ratio between the densities of the two materials $\left(\frac{\rho_x}{\rho_y}\right)$ equals



- (a) 0.46
(b) 2.15
(c) $\frac{1}{\sqrt{3}}$
(d) $\sqrt{3}$

- 20 * In the opposite figure, both groups of balls have the same mass where one group is made of metal (x) and the other group of metal (y). If all balls are solid and have equal volumes, the ratio between the densities of the two metals $\left(\frac{\rho_x}{\rho_y}\right)$ is



- (a) $\frac{3}{5}$
(b) $\frac{5}{3}$
(c) $\frac{1}{1}$
(d) $\frac{8}{3}$

- 21 * The opposite table shows some values of the density of water at different temperatures:

Temperature (°C)	Water density (kg/m ³)
3.98	1000
10	999.7
25	997.1
100	958.4

- (i) At which temperature does a cubic meter of water have the greatest mass?

- (a) 3.98°C
(b) 10°C
(c) 25°C
(d) 100°C

- (ii) At which temperature does one kilogram of water have the largest volume?

- (a) 3.98°C
(b) 10°C
(c) 25°C
(d) 100°C

- 22 * If the price of 1 g of gold is 4000 pounds, then the side length of a solid cube made of gold of price 1 million pounds equals (Where: The density of gold is $19.3 \times 10^3 \text{ kg/m}^3$)

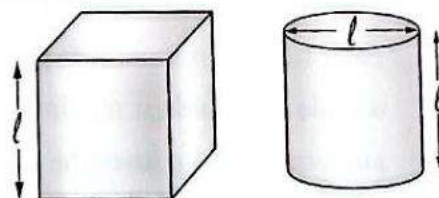
- (a) 0.01 cm
(b) 1.2 cm
(c) 1.9 cm
(d) 2.4 cm

- 23 * Two solid balls are made of different materials, the first has radius r and density ρ and the second has radius $2r$ and density 2ρ , so the ratio between their masses $\left(\frac{m_1}{m_2}\right)$ equals

- (a) $\frac{1}{2}$
(b) $\frac{1}{4}$
(c) $\frac{1}{8}$
(d) $\frac{1}{16}$

- 24 * The opposite figure shows a cube and a cylinder.

If both are made of solid iron, the ratio between the mass of the cube to that of the cylinder $\left(\frac{m_{\text{cube}}}{m_{\text{cylinder}}}\right)$ is



(Where: The volume of the cylinder = $\pi r^2 h$)

- (a) $\frac{1}{\pi}$
(b) $\frac{2}{\pi}$
(c) $\frac{4}{\pi}$
(d) $\frac{1}{1}$

- 25 * If the relative density of wood is 0.6, then:

(i) The density of wood equals

- (a) 300 kg/m^3 (b) 600 kg/m^3 (c) 1200 kg/m^3

(ii) The mass of a piece of wood of volume 0.1 m^3 is

- (a) 30 kg (b) 60 kg (c) 600 kg

(Where: $\rho_w = 1000 \text{ kg/m}^3$)
(d) 1666.67 kg/m^3

- 26 * A beaker has a mass of 230 g when it is empty. If its mass when it is filled with water is 700 g and when it is filled with oil is 600 g, then: (Given that: $\rho_{\text{water}} = 1000 \text{ kg/m}^3$)

(i) The relative density of oil equals

- (a) 1.27 (b) 1.25 (c) 0.8 (d) 0.787

(ii) The capacity of the beaker equals

- (a) 470 cm^3 (b) 500 cm^3 (c) 2000 cm^3 (d) 2128 cm^3

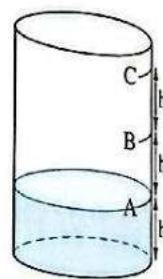
- 27 * A tank of volume capacity 60 liters has a mass of 10 kg when it is empty, what will be its mass when it gets filled with gasoline of relative density 0.72?

(Where: $\rho_{\text{water}} = 1000 \text{ kg/m}^3$)

- (a) 33.2 kg (b) 34.2 kg (c) 43.2 kg (d) 53.2 kg

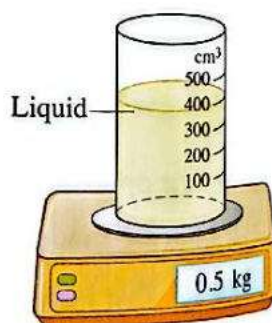
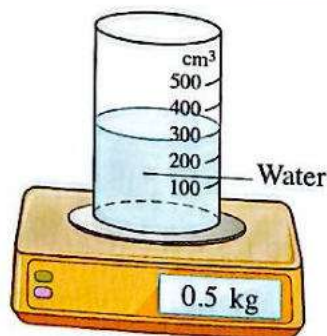
- 28 * The opposite figure shows a container of mass m containing a quantity of mass m of liquid X whose relative density is 2, then a quantity of mass m of liquid Y that is immiscible with liquid X gets added to the container till the free surface of liquid Y reaches level C, then the relative density of liquid Y equals

- (a) 1 (b) 2
(c) 3 (d) 4



- 29 * The opposite figure represents two identical beakers, one of them contains 300 cm^3 of water and the other contains 400 cm^3 of another liquid, each beaker of them was placed on a scale so that their readings were equal and equal 0.5 kg, then the relative density of the liquid is

- (a) 0.6 (b) 0.65



- (c) 0.75 (d) 0.85

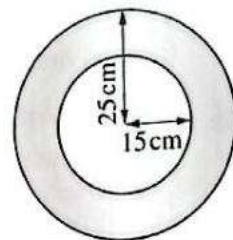
- 30 * A beaker has mass m when it is empty, then when it is filled with a liquid of density ρ_1 , its mass becomes $10m$ and when it is filled with another liquid of density ρ_2 , its mass becomes $19m$. Then, the ratio between the density of the first liquid to that of the second liquid $\left(\frac{\rho_1}{\rho_2}\right)$ equals

(a) $\frac{4}{1}$ (b) $\frac{2}{1}$ (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

- 31 * How many grams of iron are required to make an iron hollow sphere of inner radius 15 cm and outer radius 25 cm as in the opposite diagram?

(Given that: The density of iron = 7.8 g/cm^3)

(a) 293.3 g (b) $400.4 \times 10^3\text{ g}$
(c) $513.9 \times 10^3\text{ g}$ (d) $2.1 \times 10^3\text{ g}$



- 32 * A volume of 1 m^3 of water has density 10^3 kg/m^3 at 4°C and when it freezes, it converts into ice of density 917 kg/m^3 at 0°C . Then, the increase in volume when this amount of water has converted into ice equals

(a) 0.03 m^3 (b) 0.045 m^3 (c) 0.06 m^3 (d) 0.09 m^3

- 33 * A beaker of capacity 0.5 liter gets filled with a mixture of two liquids (A, B) whose densities were 800 kg/m^3 , 1800 kg/m^3 respectively, if the volume of liquid A was 0.2 liter , and with ignoring the change in the total volume of the mixture, the density of the mixture equals

(a) 1000 kg/m^3 (b) 1200 kg/m^3 (c) 1300 kg/m^3 (d) 1400 kg/m^3

- 34 * A graduated cylinder contains 40 cm^3 of glycerin whose density is 1.26 g/cm^3 , then an amount of water of density 1 g/cm^3 is added to the glycerin, so that the density of the mixture becomes 1.1 g/cm^3 . If the total volume of the liquids doesn't change after mixing them, the volume of the added water equals is

(a) 40 cm^3 (b) 44 cm^3 (c) 52 cm^3 (d) 64 cm^3

- 35 If two liquids that don't react together are mixed together in equal masses, so given that the densities of the two liquids were ρ , 3ρ , the density of the mixture is

(a) $\frac{3}{2}\rho$ (b) $\frac{2}{3}\rho$ (c) $\frac{4}{3}\rho$ (d) $\frac{3}{4}\rho$

- 36 Two quantities of two liquids X, Y that don't react with each other are mixed together, their volumes are V_{ol} , $2 V_{ol}$ respectively, if the density of liquid X is 1000 kg/m^3 and the density of liquid Y is 2000 kg/m^3 , assuming that the total volume of the liquids doesn't change after mixing, then the density of the mixture equals
- (a) 3000 kg/m^3 (b) 1666.7 kg/m^3 (c) 1500 kg/m^3 (d) 133.3 kg/m^3

- 37 * The opposite table lists the mass percentages of gold and copper in some known gold alloys, given that the densities of gold and copper are 19300 kg/m^3 , 8900 kg/m^3 respectively, which of these alloys has the least density?

Alloy	Gold percentage	Copper percentage
A	91.7 %	8.3 %
B	87.5 %	12.5 %
C	75 %	25 %
D	58.3 %	41.7 %

- (a) Alloy A (b) Alloy B
(c) Alloy C (d) Alloy D

- 38 * Four different alloys of equal masses are made by mixing two substances X and Y in different ratios such as what is shown in the opposite table in which the mass percentages of the two substances (X, Y) in each alloy are recorded. Given that the density of substance X is greater than the density of substance Y, which of these alloys has the largest volume?

Alloy	Mass percentage of substance X	Mass percentage of substance Y
A	90 %	10 %
B	30 %	70 %
C	40 %	60 %
D	80 %	20 %

- (a) Alloy A (b) Alloy B (c) Alloy C (d) Alloy D

Second Essay Questions

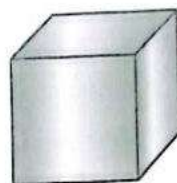
- 1 Explain the following statements:

- (1) Having an anemia can be diagnosed by measuring the density of blood.
(2) Some diseases can be diagnosed by measuring the density of urine.

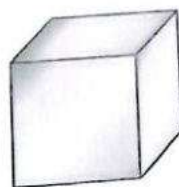
- 2 Depending on the concept of density, how can you determine if the battery of a car is charged or not?

- 3 In an experimental Physics exam students were asked to measure and record the relative density of oil. One of the students has recorded an answer which is 0.8 kg/m^3 and another has recorded an answer of 0.8. Which of the two students gives the correct answer? And why?

- 4 The opposite diagram shows two cubes, each of volume 1000 cm^3 . One is made of iron and its mass is 7.9 kg and the other is made of aluminum and its mass is 2.7 kg :



Iron



Aluminum

- (a) Calculate the density of each of the iron and the aluminum.

- (b) Why are the densities of the two metals different?

- 5 If you have two identical buckets one is filled with water and the other filled with oil, which of them requires greater force to be lifted? Explain your answer. (Where: $\rho_{\text{oil}} < \rho_{\text{water}}$)

- 6 A homogeneous alloy is composed of two metals a and b whose densities are ρ and 3ρ respectively and their volumes in the alloy are $2V_{\text{ol}}$ to V_{ol} respectively. Given that the volume of the alloy is equal to the sum of volumes of the two metals before mixing them, calculate the mass of the alloy in terms of ρ and V_{ol} .

Questions that measure high levels of thinking

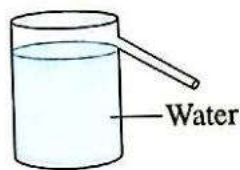
Answered in detail

Choose the correct answer:

- 1 Given that the density of ice is $X \text{ g/L}$ and the density of water at 0°C is $Y \text{ g/L}$, so the magnitude of decrease in the volume of a piece of ice of mass m when it melts down at 0°C is

- (a) $mY(X - Y)$ (b) $m(Y - X)$ (c) $m\left(\frac{1}{X} - \frac{1}{Y}\right)$ (d) $\frac{Y - X}{X}$

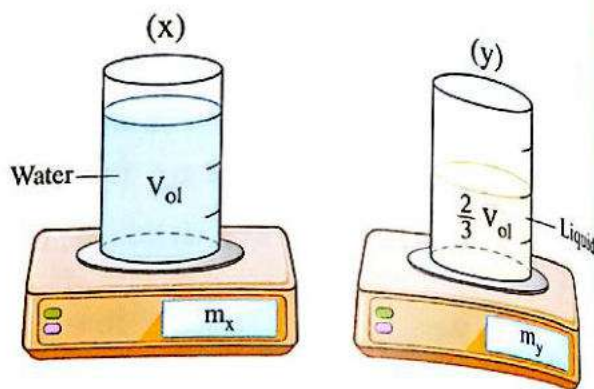
- 2 The opposite figure illustrates a displacement can filled with water, so when a piece of copper of mass 531.25 g is immersed into the water inside the can, an amount of water of mass 62.5 g gets displaced (spilled), so the density of copper is



(Given that: $\rho_{\text{water}} = 1000 \text{ kg/m}^3$)

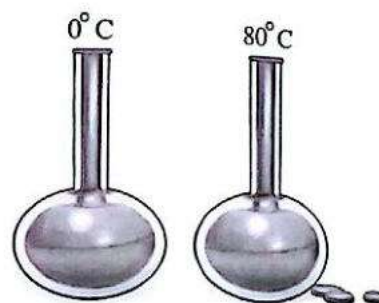
- (a) 5312.5 kg/m^3 (b) 6250 kg/m^3 (c) 7500 kg/m^3 (d) 8500 kg/m^3

- 3 The opposite figures represent two identical cups x, y, each is placed on a scale, cup x contains a volume of water V_{ol} whose mass is three times the mass of the cup and cup y contains a liquid whose relative density is 1.4 and its volume is $\frac{2}{3} V_{ol}$, then the ratio between the readings of the two scales ($\frac{m_x}{m_y}$) equals



- (a) $\frac{19}{20}$ (b) $\frac{14}{15}$ (c) $\frac{15}{14}$ (d) $\frac{20}{19}$

- 4 A flask of volume 60 mL is filled completely with mercury at 0°C and when its temperature is raised to 80°C , about 1.47 g of mercury gets spilled out from the flask as shown in the opposite figure. Then, if the density of mercury at 0°C is 13595 kg/m^3 with assuming that the volume of the flask remains constant, the density of mercury at 80°C equals



- (a) 12960 kg/m^3 (b) 13320 kg/m^3 (c) 13570.5 kg/m^3 (d) 13619.5 kg/m^3
- 5 A metallic alloy has a mass of 750 g where 60% of its mass is magnesium while the other part is copper. If the density of magnesium is 1.7 g.cm^{-3} and the density of copper is 9 g.cm^{-3} , so the relative density of the material of the alloy equals (Where: $\rho_{\text{water}} = 1 \text{ g/cm}^3$)
- (a) 2.5 (b) 4.6 (c) 5.4 (d) 10.7

- 6 Three metals X, Y and Z have densities ρ , 1.5ρ and 2ρ respectively, so which of the following volume ratios of the three metals in the table below when mixed together gives an alloy that has the highest density, assuming that the change in the total volume while forming the alloy is ignored?

Alloy	Volume ratio of metal X	Volume ratio of metal Y	Volume ratio of metal Z
(a)	1	4	3
(b)	2	1	0.5
(c)	3	1	4
(d)	5	1	2

Questions ?

Chapter 4 | Lesson 2

Answered

Flow

Interactive test

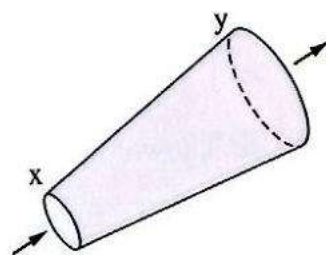


First

Multiple Choice Questions

Questions signed by * are answered in detail.

- In laminar flow of liquids, the ratio between the number of streamlines passing in the wide part of a tube to that in the narrow part of the same tube is
 (a) greater than one (b) less than one (c) equal to one (d) indeterminable
- In laminar flow, when the cross-sectional area of the tube decreases, the density of streamlines
 (a) increases (b) decreases (c) vanishes (d) remains unchanged
- The continuity equation of liquid flow can be deduced from the law of conservation of
 (a) mass (b) energy (c) momentum (d) density
- The number of streamlines of a liquid which passes perpendicularly through a unit area surrounding a certain point indicates
 (a) the liquid speed at that point (b) the volume flow rate
 (c) the mass flow rate (d) the liquid density
- Water flows steadily through a tube XY such that its speed and its volume flow rate at cross-section X are v , Q_v respectively. If the water speed at cross-section Y is $\frac{v}{2}$, then its volume flow rate at cross-section Y is equal to
 (a) $2Q_v$ (b) Q_v (c) $\frac{Q_v}{2}$ (d) $\frac{Q_v}{4}$
- In the opposite figure, a liquid flows steadily in a tube, so the physical quantity which is greater at cross-section x than at cross-section y is
 (a) the liquid speed
 (b) the volume of the flowing liquid in unit time
 (c) the mass of the flowing liquid in unit time
 (d) the number of the streamlines through the cross-section



- 7 The ratio between the mass flow rate and the volume flow rate for a liquid that flows steadily equals
- (a) the cross-sectional area of the tube (b) the time of liquid flow
(c) the speed of liquid flow (d) the liquid density
- 8 A liquid of density 1000 kg/m^3 flows steadily inside a tube of cross-sectional area 0.5 m^2 with a flow rate of 10 kg/s , then the flow speed of the liquid through the tube is equal to
- (a) 200 m/s (b) 50 m/s (c) 0.02 m/s (d) 0.05 m/s
- 9 The cross-sectional areas of the two ends of a tube are 0.005 m^2 and 0.01 m^2 . If water flows through the tube steadily and the volume of the flowing water within 15 minutes is 9 m^3 , the speed of the water in

	The wide cross-section	The narrow cross-section
(a)	0.6 m/s	1.5 m/s
(b)	1 m/s	1.5 m/s
(c)	0.6 m/s	2 m/s
(d)	1 m/s	2 m/s

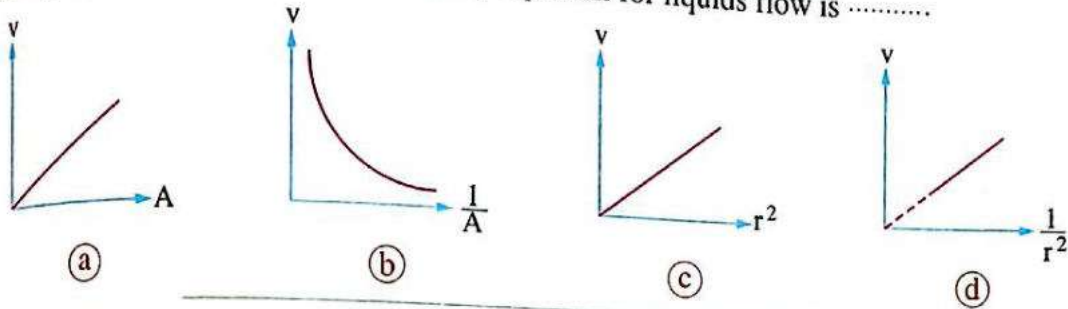
- 10 * Water flows steadily in a tube of diameter 2 cm at a speed of 5 m/s . Thus;
- (i) The volume of water which is flowing through the cross-section of the tube in one minute equals (Where: $\pi = 3.14$)
- (a) 9.42 m^3 (b) 0.19 m^3 (c) 0.0942 m^3 (d) 0.001 m^3
- (ii) The time required to fill a tank of volume 20 m^3 by using the flowing water from the tube is
- (a) 127.38 minutes (b) 212.31 minutes (c) 3.54 minutes (d) 2.123 minutes
- 11 * A water pipe has cross-sectional area 4 cm^2 at the ground floor and 2 cm^2 at the upper floor. If water is flowing steadily inside the pipe such that its speed at the ground floor was 2 m/s , then:
- (Given that: Water density = 1000 kg/m^3)
- (i) The water flow speed at the upper floor is
- (a) 1 m/s (b) 2 m/s (c) 3 m/s (d) 4 m/s
- (ii) The volume flow rate of water at the ground floor equals
- (a) $4 \times 10^{-4} \text{ m}^3/\text{s}$ (b) $6 \times 10^{-4} \text{ m}^3/\text{s}$ (c) $8 \times 10^{-4} \text{ m}^3/\text{s}$ (d) $12 \times 10^{-4} \text{ m}^3/\text{s}$
- (iii) The mass flow rate of water at the upper floor equals
- (a) 1.2 kg/s (b) 0.8 kg/s (c) 0.6 kg/s (d) 0.4 kg/s

- 12 A water pipe of diameter 2.5 cm is used to pour an amount of water of mass 11 kg in a bowl. If it takes 10 s to pour this amount into the bowl, the speed of the water while emerging from the pipe equals
 (a) 2 m/s (b) 2.24 m/s (c) 3 m/s (d) 3.32 m/s
 (Knowing that: $\rho_{\text{water}} = 1000 \text{ kg/m}^3$, $\pi = \frac{22}{7}$)

- 13 Water flows through a hose of diameter 1.2 cm at a speed of 3 m/s. If the speed of the water that comes out of the nozzle is 27 m/s, the diameter of the nozzle of the hose equals
 (a) 0.2 cm (b) 0.4 cm (c) 0.6 cm (d) 0.8 cm

- 14 If the cross-sectional area of a tube in which a liquid flows steadily gets increased to the double, the mass flow rate
 (a) increases to the double
 (b) decreases to its half
 (c) remains constant
 (d) decreases to its quarter

- 15 The graph that represents the continuity equation for liquids flow is



- 16 A liquid flows steadily in a tube of radius r at a speed of 4 m/s, if the radius of the tube increases to reach $2r$ at its end, the emergence speed of the liquid out of the tube equals
 (a) 1 m/s (b) 2 m/s (c) 4 m/s (d) 8 m/s

- 17 Oil flows through a cross-section of tube x at a rate of 6 liters/minute and gets out from another tube y which is connected to the first tube x at a speed of 4 m/s, if the oil flows steadily through the two tubes, the cross-sectional area of the second tube y equals
 (a) $1.5 \times 10^{-3} \text{ m}^2$ (b) 1.5 m^2 (c) $2.5 \times 10^{-5} \text{ m}^2$ (d) 0.025 m^2

- 18 Water flows steadily in a tube of cross-sectional area 10^{-3} m^2 , if the volume of water which is coming out from the tube within 30 minutes is 18 m^3 , then

	Volume flow rate (m^3/s)	Speed of water flow (m/s)
(a)	0.01	10
(b)	0.01	600
(c)	0.6	10
(d)	0.6	600

- 19 If the cross-sectional area of a tube has increased to the double in steady flow, the flow speed

(a) gets doubled
(c) gets quadrupled

(b) decreases to half its value
(d) remains constant

- 20 If the ratio between the radii of two cross-sections of a tube in steady flow is $\frac{1}{2}$, the ratio between the speeds of the liquid through them respectively is

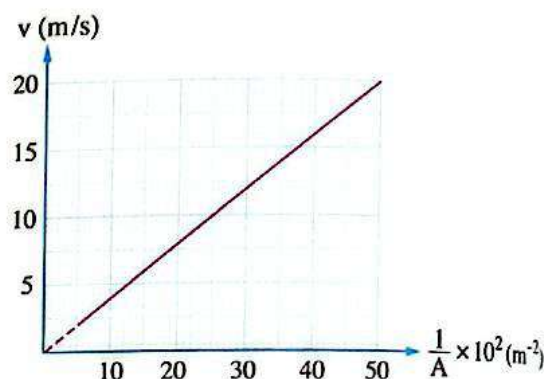
(a) $\frac{1}{4}$

(b) $\frac{1}{2}$

(c) $\frac{2}{1}$

(d) $\frac{4}{1}$

- 21 The opposite graph illustrates the relation between the liquid flow speed (v) at a point in a tube and the reciprocal of the cross-sectional area of the tube ($\frac{1}{A}$) at that point, then:



- (i) The volume flow rate equals

(a) $40 \text{ m}^3/\text{s}$

(b) $4 \text{ m}^3/\text{s}$

(c) $0.4 \text{ m}^3/\text{s}$

(d) $0.004 \text{ m}^3/\text{s}$

- (ii) The mass of the flowing liquid within 30 minutes if the liquid density is 1000 kg/m^3 equals

(a) 120 kg

(b) 1200 kg

(c) 7200 kg

(d) $7.2 \times 10^5 \text{ kg}$

- 22 * An oil pump pumps 1.2 m^3 of oil within 60 s in a cylindrical tank of diameter 4 m and height 3 m. If the oil density is 820 kg/m^3 , then:

- (i) The mass flow rate of the oil from the pump opening equals

(a) 0.02 kg/s

(b) 5.2 kg/s

(c) 16.4 kg/s

(d) 18.4 kg/s

- (ii) The time required to fill the tank with oil is

(a) 27.21 minutes

(b) 31.43 minutes

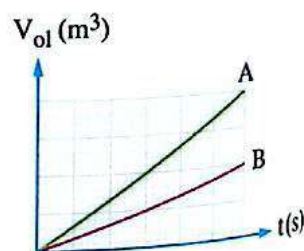
(c) 42.43 minutes

(d) 51.54 minutes

- 23 Two liquids A, B have densities in a ratio of $\left(\frac{\rho_A}{\rho_B} = \frac{2}{1}\right)$, each flows steadily in a different tube.

The opposite graph represents the relation between the liquid volume (V_{ol}) that flows through a cross-section of each tube and the flow time (t), then the ratio between the mass flow rates of the two

liquids $\left(\frac{Q_m}{Q_m}\right)_A$ equals



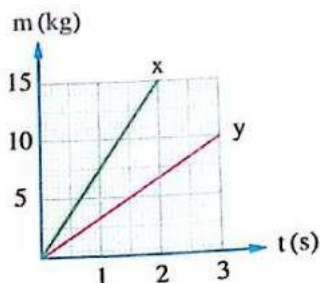
(a) $\frac{1}{2}$

(b) $\frac{2}{1}$

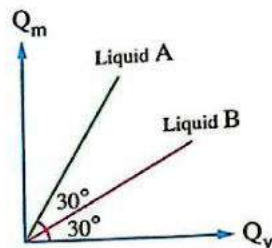
(c) $\frac{1}{4}$

(d) $\frac{4}{1}$

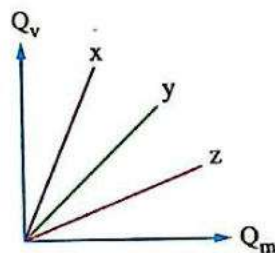
- 24 * Two liquids x, y flow steadily in two different tubes of the same cross-sectional area with two different speeds $1.25 v$ and v respectively. The opposite graph represents the relation between the mass (m) of the liquid which flows through the cross-section of each tube and the flow time (t), then the ratio between the densities of the two liquids ($\frac{\rho_x}{\rho_y}$) equals
- (a) $\frac{9}{5}$ (b) $\frac{3}{2}$ (c) $\frac{2}{3}$ (d) $\frac{5}{9}$



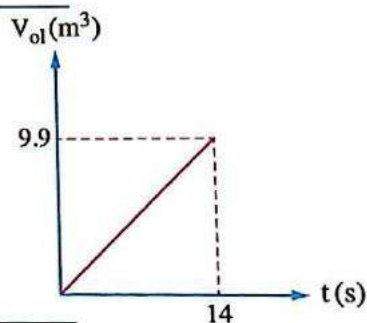
- 25 Two liquids A, B flow steadily in two similar tubes, where the relation between their mass flow rate (Q_m) and their volume flow rate (Q_v) is represented graphically as in the opposite figure, then the ratio between their densities ($\frac{\rho_A}{\rho_B}$) equals
- (a) $\frac{1}{2}$ (b) $\frac{3}{2}$
(c) $\frac{2}{1}$ (d) $\frac{3}{1}$



- 26 * The opposite graph represents the relation between the volume flow rate (Q_v) and the mass flow rate (Q_m) for each of three liquids x, y and z where each flows steadily in a different tube, so
- (a) $\rho_z < \rho_x < \rho_y$ (b) $\rho_z < \rho_y < \rho_x$
(c) $\rho_y < \rho_x < \rho_z$ (d) $\rho_x < \rho_y < \rho_z$

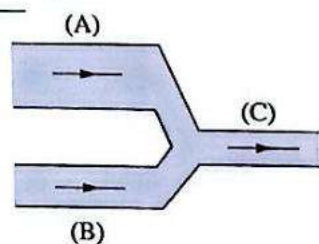


- 27 The opposite graph represents the relation between the volume (V_{ol}) of a liquid that flows steadily in a uniform tube and the flow time (t), if the flow speed of the liquid is 0.9 m/s , the radius of the tube equals
- (a) 0.3 m (b) 0.5 m
(c) 0.9 m (d) 1.2 m



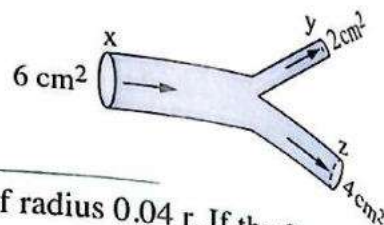
- 28 If the volume flow rate of a liquid is Q_v in a pipe that is branched into four branches of equal cross-sectional areas, the flow rate in each branch equals
- (a) $4 Q_v$ (b) $\frac{1}{3} Q_v$ (c) Q_v (d) $\frac{1}{4} Q_v$

- 29 In the opposite figure, tubes (A) and (B) are different in cross-sectional area and the volume flow rate of the liquid inside each of them is $0.3 \text{ m}^3/\text{s}$. The two tubes meet to open in the tube (C) as in the figure, then the volume flow rate in the tube (C) is
- (a) $0.1 \text{ m}^3/\text{s}$ (b) $0.3 \text{ m}^3/\text{s}$ (c) $0.6 \text{ m}^3/\text{s}$ (d) $0.9 \text{ m}^3/\text{s}$



- 30 In the opposite figure, the speeds of the steady flow of water at x and z are 8 m/s and 4 m/s respectively, then its speed at y is

(a) 16 m/s (b) 12 m/s
(c) 8 m/s (d) 6 m/s



- 31 A tube of radius r branches into a number of tubes, each of radius $0.04 r$. If the flow speed of the liquid in any of these tubes is five times its speed in the main tube, the number of the small tubes is

(a) 5 (b) 125 (c) 140 (d) 150

- 32 Blood flows through an artery with an average speed of 0.24 m/s. If the artery branches into 120 smaller arteries each of diameter that is $\frac{1}{4}$ of the big one, the average flow speed of blood in every small artery equals

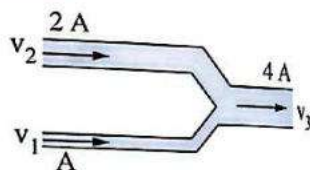
(a) 8×10^{-3} m/s (b) 0.08 m/s (c) 0.032 m/s (d) 0.3 m/s

- 33 Water flows with speed v through a main pipe that is branched into a number of pipes each of diameter $\frac{1}{15}$ of the main pipe's diameter. So, to keep the speed of flow in the branched pipes the same as in the main pipe, the number of the branched pipes should be

(a) 100 (b) 125 (c) 200 (d) 225

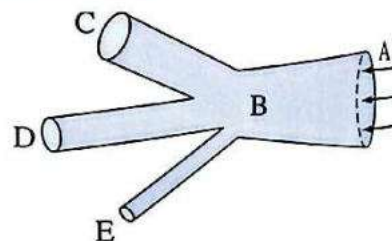
- 34 The opposite figure shows a steady flow of water in a tube. If $v_1 = 2 v_2$, the speed of water (v_3) equals

(a) v_1 (b) $\frac{v_1}{2}$
(c) $2 v_1$ (d) $3 v_1$



- 35 The following table shows the data which describes the flow of water in the opposite figure: (Take : $\pi = 3.14$)

Section	Radius (cm)	Flow speed (m/s)
A	30	2
B	20	v_B
C	15	3
D	10	v_D
E	5	15



Then:

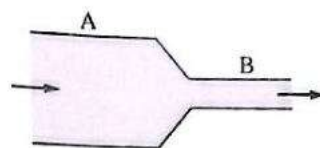
- (i) The volume flow rate at (A) equals

(a) $0.2826 \text{ m}^3/\text{s}$ (b) $0.5652 \text{ m}^3/\text{s}$ (c) $1.884 \text{ m}^3/\text{s}$ (d) $5.652 \text{ m}^3/\text{s}$

- (ii) The flow speed of water at cross-section B equals
 (a) 1.3 m/s (b) 2.5 m/s (c) 4.5 m/s (d) 5.6 m/s
 (iii) The flow speed of water at cross-section D equals
 (a) 1.56 m/s (b) 7.5 m/s (c) 10 m/s (d) 12.5 m/s

Second Essay Questions

1 The opposite figure shows a liquid that flows steadily in a tube, **determine which of the following ratios is greater than, less than or equal to one:**



- The ratio between the streamlines density at cross-section A and the streamlines density at cross-section B.
- The ratio between the volume flow rate at cross-section A and the volume flow rate at cross-section B.
- The ratio between the mass flow rate at cross-section A and the mass flow rate at cross-section B.
- The ratio between the speed of liquid flow at cross-section A and the speed of liquid flow at cross-section B.

2 **Explain the following statements:**

- Streamlines in steady flow become crowded at the cross-section of high liquid speeds.
- In steady flow, the liquid flow rate is always constant at any cross-section of the tube.
- In steady flow, the liquid flow is slow at the wider cross-section of the tube and fast at the narrower cross-section of the tube.
- The cross-sectional area of the water column flowing from the nozzle of a hose decreases when it is directed downwards and increases when it is directed upwards.
- The openings of the gas stove are made small.

3 In October War, the Egyptian Army used water pumps to rush water through hoses with narrow nozzles to open paths in Bar Lev Line, **why do you think** the hose nozzles should be narrow?

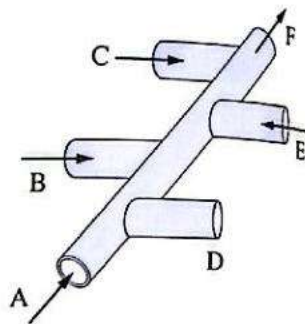
4 **What are the results of the following (mention the reason if possible):**

- A main artery is ended by a large number of blood capillaries concerning blood speed?
- The end of a tube tapers to a narrow opening concerning the speed of the steady flow of the liquid?

Choose the correct answer:

- 1 A water tank takes 10 minutes to be filled using three water taps together, takes 20 minutes when using the first water tap only and an hour when using the second water tap only, then the time required to fill the tank using the third water tap only is
- (a) 10 minutes (b) 20 minutes (c) 30 minutes (d) 60 minutes

- 2 The opposite figure shows a tube that has different branches through which water flows steadily. If the volume flow rates at branches A, B, C, E and F are $6 \text{ cm}^3/\text{s}$, $3 \text{ cm}^3/\text{s}$, $5 \text{ cm}^3/\text{s}$, $4 \text{ cm}^3/\text{s}$ and $3 \text{ cm}^3/\text{s}$ respectively, then



	Direction of water flow in branch D	Volume flow rate of water in branch D
(a)	into	$7 \text{ cm}^3/\text{s}$
(b)	into	$15 \text{ cm}^3/\text{s}$
(c)	out	$7 \text{ cm}^3/\text{s}$
(d)	out	$15 \text{ cm}^3/\text{s}$

Questions ?

Chapter 4 | Lesson 3

Answered

Viscosity

Interactive test



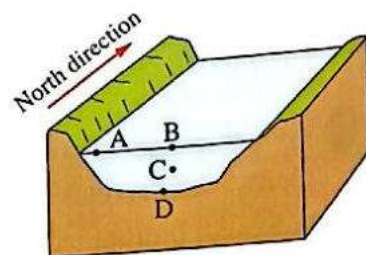
First

Multiple Choice Questions

Questions signed by * are answered in detail.

- 1 The resistance of a liquid to the motion of objects inside it is a result of
- (a) the liquid density
 - (b) the liquid viscosity
 - (c) the weight of the liquid
 - (d) the buoyant force of the liquid

- 2 The opposite figure shows a cross-section in the Nile River. In this section the river flows to the north. At which of the shown points in the figure is the greatest flow speed?



- (a) At point A
- (b) At point B
- (c) At point C
- (d) At point D

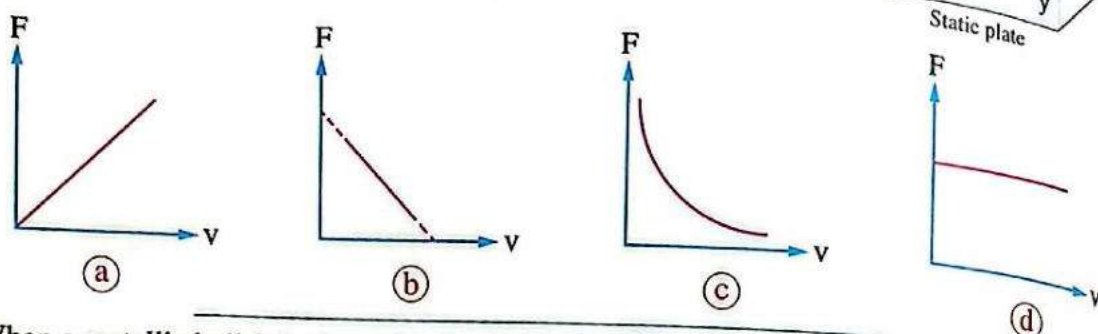
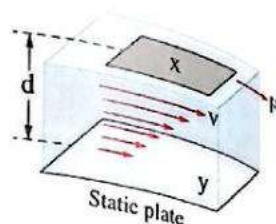
- 3 If the speed difference between two liquid layers gets decreased when a tangential force is acting on the upper layer at the same temperature, the viscosity coefficient

- (a) vanishes
- (b) decreases but doesn't vanish
- (c) increases
- (d) remains constant

- 4 If the temperature of a viscous liquid increases, then

	The flow rate of the liquid	The resistance of the liquid against the motion of bodies inside it
(a)	increases	increases
(b)	decreases	increases
(c)	increases	decreases
(d)	decreases	decreases

- 5 Which of the following graphs represents the relation between the force (F) which is required to move plate x with a uniform velocity v on the surface of a liquid parallel to a static plate y and the speed (v) of plate x ?



- 6 When a metallic ball falls through a liquid in a jar, the viscosity force of the liquid which is acting on the ball depends on
- (a) the ball radius (b) the liquid density (c) the ball mass (d) the liquid quantity

- 7 Four identical solid balls are dropped from the same height into four cylinders, each of them contains the same volume of different liquid while the time taken by each ball to reach the bottom of the cylinder is recorded as the following table:

Cylinder	Time
1	0.2 s
2	0.3 s
3	0.6 s
4	1 s

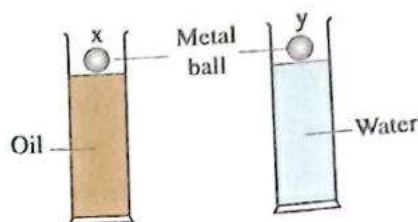
Which cylinder contains the liquid of the highest viscosity?

- (a) Cylinder 1 (b) Cylinder 2 (c) Cylinder 3 (d) Cylinder 4
- 8 * When a swimmer jumps into water and reaches a certain depth then rise again to the surface, the force that changes its direction will be
- (a) the swimmer weight
(b) the frictional force between the swimmer and water
(c) the buoyant force of water that acts on the swimmer
(d) all of these forces

- 9 A metallic ball has fallen once through water and another time through honey. If the average frictional force between the ball and water is F_1 and between the ball and honey is F_2 , which of the following statements for F_1 and F_2 is correct?

- (a) $F_1 = F_2 = 0$ (b) $F_1 = F_2 \neq 0$ (c) $F_1 > F_2$ (d) $F_1 < F_2$

- 10 The opposite figure shows two identical metal balls (x, y) falling from the same height into two identical jars containing similar volumes of oil and water till reaching the bottoms, then the average speed of ball x is

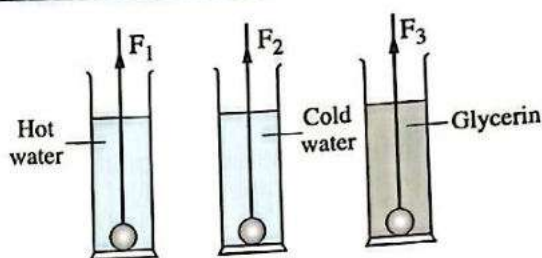


- (a) greater than the average speed of ball y
(b) less than the average speed of ball y
(c) equal to the average speed of ball y
(d) equal to its instantaneous speed at the bottom of the jar

- 11 A viscous liquid flows steadily in a cylindrical tube. If the liquid speed along the tube axis is v , the speed of the liquid layer which touches the tube walls equals

- (a) $2v$ (b) v (c) $\frac{v}{2}$ (d) zero

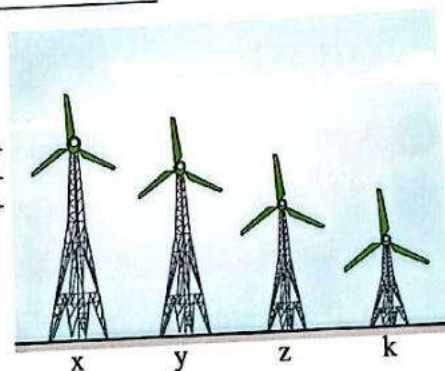
- 12 * The opposite figure shows three identical metal balls, each of them is tied by a thread and placed at the bottom of one of three similar cylinders that contain three equal volumes of different liquids. Through which of these liquids the ball faces a greater resistance when it gets pulled out from the liquid with the same uniform speed?



- (a) In the hot water. (b) In the cold water.
(c) In glycerin. (d) The same force in all cases.

- 13 The opposite figure shows four windmills of identical turbines and blades installed near each other at different heights to be used for generating electricity, so the windmill that has the greater potential of generating electricity will be

Direction of air movement →



- (a) x (b) y
(c) z (d) k

- 14 At relatively low or medium speeds of a car, the air resistance due to air viscosity is

- (a) directly proportional to the square of the speed of the car
(b) directly proportional to the speed of the car
(c) inversely proportional to the square of the speed of the car
(d) inversely proportional to the speed of the car

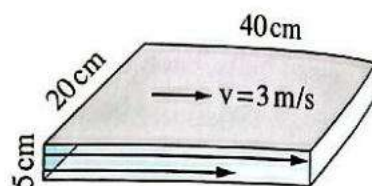
15 At high speeds of a car, the air resistance due to air viscosity is

- (a) directly proportional to the speed of the car
- (b) inversely proportional to the speed of the car
- (c) directly proportional to the square of the speed of the car
- (d) inversely proportional to the square the speed of the car

16 Two cars (x, y) have travelled for the same distance with different speeds of 20 km/h and 160 km/h respectively. If the amount of fuel consumed in car x to cover this distance is Q, the amount of fuel consumed in car y to cover the same distance is

- (a) equal to Q
- (b) greater than Q
- (c) less than Q
- (d) indeterminable

17 If a tangential force of 10 N acted upon the upper plate to move it at a uniform speed of 3 m/s on a liquid layer in the direction shown in the figure, the viscosity coefficient of the liquid equals



- (a) 0.021 N.s/m^2
- (b) 0.48 N.s/m^2
- (c) 0.75 N.s/m^2
- (d) 2.08 N.s/m^2

18 A circular plate of radius 7 cm slides at a uniform speed of 0.1 m/s on a ceramic floor covered with a layer of viscous liquid of thickness 2.5 mm and viscosity coefficient 2.5 N.s/m^2 , then the tangential force acting on the plate is

- (a) 1.54 N
- (b) 1.32 N
- (c) 1.24 N
- (d) 1.12 N

19 A rectangular plate of dimensions 50 cm, 25 cm is affected by a tangential force of 15 N which moves it at a constant speed of 0.8 m/s on a layer of viscous liquid of thickness 9.375 mm, so the viscosity coefficient of the liquid is

- (a) 0.42 kg/m.s
- (b) 0.85 kg/m.s
- (c) 1.41 kg/m.s
- (d) 2.31 kg/m.s

20 When a tangential force F acts on a plate of area A placed on another static plate where a layer of liquid of thickness d is in between, the upper plate moves with a uniform velocity v. What is the tangential force that makes the upper plate moves with a constant velocity 2 v under the same conditions?

- (a) F
- (b) 2 F
- (c) $\frac{F}{2}$
- (d) $\frac{F}{4}$

- 21 A plate of area A slides with a uniform velocity on the water surface in two cases as shown in figures (1), (2), so the ratio between the forces $\left(\frac{F_1}{F_2}\right)$ that are required to keep

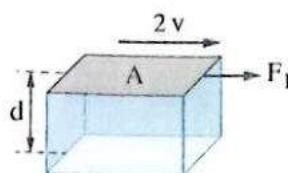


Figure (1)

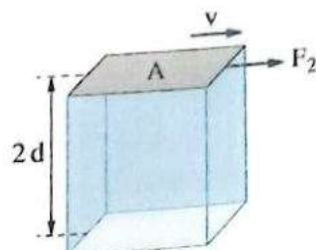


Figure (2)

the plate moving in the same velocity in each case equals

- (a) $\frac{1}{1}$ (b) $\frac{1}{2}$ (c) $\frac{2}{1}$ (d) $\frac{4}{1}$

- 22 A layer of a viscous liquid of thickness 8 cm is put between two parallel horizontal plane plates. If the viscosity coefficient of the liquid is 0.8 kg/m.s , then the force required to move a thin plate of area 0.5 m^2 between the two plates, parallel to them with a uniform speed of 2 m/s and at a distance of 2 cm from one of them equals

- (a) 13.33 N (b) 26.67 N (c) 40.52 N (d) 53.33 N

- 23 A layer of thickness X meters of a liquid of viscosity 0.2 kg/m.s is confined between two plates, one of the plates is static and the other which has an area of 2 cm^2 is moving with a uniform velocity such that it covers a distance $100X$ meters through a time interval of 4 s, so the required force to move the plate equals

- (a) 10 N (b) 10^{-3} N (c) 10^{-4} N (d) 0.1 N

- 24 * The opposite figure shows a boat pulling a skater to move with a uniform velocity v , if the tangential force which is acting on the boat is F_1 and the tangential force which is acting on the skating board is F_2 ,



- (a) $F_1 > F_2$ (b) $F_1 < F_2$
(c) $F_1 = F_2 = 0$ (d) $F_1 = F_2 \neq 0$

Second Essay Questions

- 1 Explain the following statements:

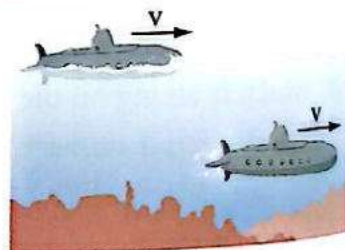
- (1) Aqueous plants grow close to the riverbanks.
- (2) The speed of the sea waves decreases as they get closer to the shore.
- (3) People who are living in high floors feel the wind speed more than those who are living in the ground floor.

- (4) As the viscosity of a liquid increases, its resistance to the motion of a solid body inside it increases.
- (5) A liquid restores its static condition after a while of stirring it.
- (6) It is hard to swim against the current in the middle of the river.
- (7) Moving an object in water is harder than it is in air.
- (8) It is very important to use oil to lubricate the metallic machines regularly.
- (9) Engine oils that are used in summer must be more viscous than those which are used in winter.
- (10) Using materials of high viscosity to lubricate the metallic machines.
- (11) Water is not suitable to lubricate the metallic machines.
- (12) The sedimentation rate of red blood cells decreases in anemia patients.
- (13) The sedimentation rate of red blood cells increases in rheumatic fever patients.
- (14) Doctors can diagnose some diseases through sedimentation rate test.

2 What are the results of each of the following, give reasons:

- (1) Increasing the area of a plate that moves with a constant speed in a viscous liquid to the double, concerning the required tangential force to move the plate.
- (2) Decreasing the temperature of a liquid, concerning its viscosity.
- (3) Not lubricating the moving machines regularly.
- (4) Exceeding a certain limit for the car speed, concerning the fuel consumption.
- (5) Dropping a metal ball in a viscous liquid, concerning its momentum.

3 In which case does the submarine need a larger force to push it with a certain uniform velocity v , under water or while floating?



4 During a Nile cruise from Aswan to Cairo, the ship captain sails the ship in the middle of the river stream but during the return from Cairo to Aswan he sails close to the shore. How do you explain this?

Questions ?

Chapter

5 | Lesson 1

Answered

Pressure

Interactive test



First

Multiple Choice Questions

Questions signed by * are answered in detail.

Pressure

1 Pressure is measured in

(a) kg.s^{-2}

(b) $\text{kg.m}^{-1}.\text{s}^{-2}$

(c) N.m^{-1}

(d) N.m^2

2 In which of the following figures the pressure exerted by the weight of the child on the ground is the lowest?



(a)



(b)



(c)



(d)

3 * A fish tank of base area 1000 cm^2 containing water of weight 4000 N while being placed on a horizontal surface, so the pressure of water at the bottom of the tank equals

(a) 400 N/m^2

(b) 4000 N/m^2

(c) $4 \times 10^4 \text{ N/m}^2$

(d) $4 \times 10^6 \text{ N/m}^2$

4 * A force of 15 N acted on a surface of area 2 cm^2 such that the vector of the force makes an angle of 30° with the normal to the surface, so the pressure acted on the surface equals

(a) $1.875 \times 10^4 \text{ N/m}^2$

(b) $3.248 \times 10^4 \text{ N/m}^2$

(c) $37.5 \times 10^3 \text{ N/m}^2$

(d) $64.95 \times 10^3 \text{ N/m}^2$

5 * A brick is placed horizontally on a horizontal surface as in figure (1), if its orientation is changed to be as in figure (2), which of the following choices represents the effect of this change on each of the force and the pressure due to the brick on the contact surface?

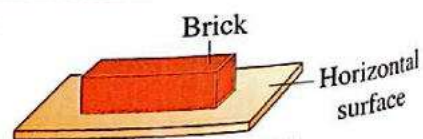


Figure (1)

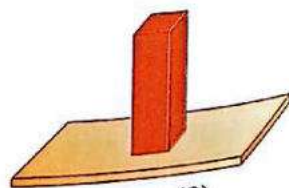
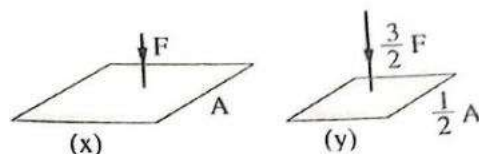


Figure (2)

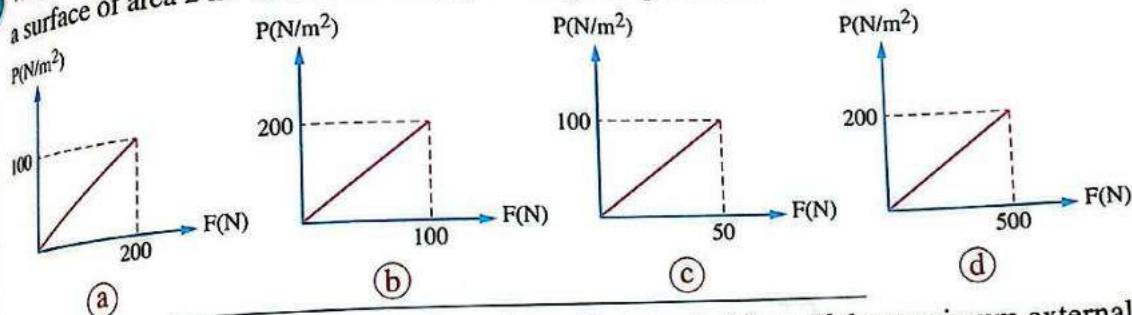
	The force	The pressure
(a)	Increases	Decreases
(b)	Increases	Remains constant
(c)	Remains constant	Increases
(d)	Remains constant	Remains constant

- Two plane surfaces (x, y) have areas $A, \frac{1}{2}A$, each of them is affected by a force as shown in the opposite figure, so which of the following choices is correct?



- (a) $P_x > P_y$
(b) $P_x < P_y$
(c) $P_x = P_y$
(d) Indeterminable

- Which of the following graphs represents the relation between the pressure (P) acting on a surface of area 2 m^2 and the force (F) causing that pressure?



- * A submarine has a circular window whose diameter is 0.3 m. If the maximum external pressure that the window can withstand is 660 kPa, so the minimum external force that can break the window is approximately equal to

- (a) $40 \times 10^3 \text{ N}$ (b) $47 \times 10^3 \text{ N}$ (c) $90 \times 10^3 \text{ N}$ (d) $120 \times 10^3 \text{ N}$

- A man of weight w is standing on the ground with both of his feet. If the contact area of each foot with the ground is A , the man affects the ground with a pressure that equals

- (a) $\frac{2w}{A}$ (b) $\frac{w}{A}$ (c) $\frac{w}{2A}$ (d) $\frac{w}{4A}$

- * A solid cuboid of dimensions 10 cm, 5 cm, 2.5 cm and mass 1 kg is placed on a horizontal plane surface. Then: (Given that: $g = 10 \text{ m/s}^2$)

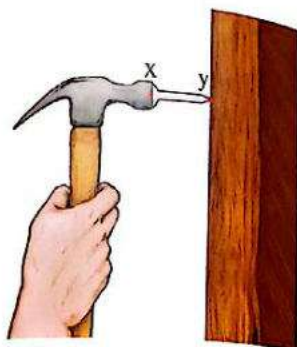
- (i) The density of the cuboid material equals
- (a) 8000 kg/m^3 (b) 6400 kg/m^3 (c) 5600 kg/m^3 (d) 4200 kg/m^3
- (ii) The highest pressure by which the cuboid could affect the surface equals
- (a) 2000 N/m^2 (b) 4000 N/m^2 (c) 8000 N/m^2 (d) 10000 N/m^2
- (iii) The lowest pressure by which the cuboid could affect the surface equals
- (a) 2000 N/m^2 (b) 4000 N/m^2 (c) 6000 N/m^2 (d) 8000 N/m^2

- * A cube of side length 10 cm and a cuboid made of the same material whose dimensions are 30 cm, 20 cm and 10 cm are placed on a horizontal surface. The face on which the cuboid can be placed on the surface to produce a pressure equal to the pressure produced by the cube is the face of dimensions

- (a) $20 \text{ cm} \times 10 \text{ cm}$ (b) $30 \text{ cm} \times 10 \text{ cm}$
(c) $30 \text{ cm} \times 20 \text{ cm}$ (d) the pressure produced by both cannot be equal

12. A solid alloy that is in the form of a cuboid is placed on a horizontal surface where the vertical dimension is 80 cm, if the pressure of the cuboid on the surface is 15200 Pa, then the density of the alloy equals
 (Take: $g = 10 \text{ m/s}^2$)
 (a) 1800 kg/m^3 (b) 1900 kg/m^3 (c) 2000 kg/m^3 (d) 2200 kg/m^3

13. The opposite figure shows a hammer exerting a force F on a nail that in turn exerts the same force on a piece of wood, so the ratio between the pressure resulted on the nail at point x and the pressure resulted on the piece of wood at point y ($\frac{P_x}{P_y}$) is



- (a) greater than one (b) less than one
 (c) equal to one (d) we can't determine the answer

14. * A man sits on a chair of four legs while his feet don't touch the ground, so if the mass of both the man and the chair together is 95 kg and the legs of the chair have circular ends, each of radius 0.5 cm, then the pressure that each leg produces on the ground equals
 (Take: $g = 9.8 \text{ m/s}^2$)
 (a) $2.96 \times 10^6 \text{ Pa}$ (b) $5.92 \times 10^6 \text{ Pa}$ (c) $11.85 \times 10^6 \text{ Pa}$ (d) $14.81 \times 10^6 \text{ Pa}$

15. * In the opposite figure, a man holds a drawing pin between his thumb and index fingers where he presses on the head of the pin with his thumb by a force of 0.5 N without letting the tip injure him. If the area of the head of the pin is $6 \times 10^{-5} \text{ m}^2$, then:



(i) The force of the tip of the pin on the index equals

- (a) 0.5 N (b) 1 N (c) 2 N (d) 4 N

(ii) The pressure due to the head of the pin is approximately equal to

- (a) $4 \times 10^3 \text{ N/m}^2$ (b) $8 \times 10^3 \text{ N/m}^2$ (c) $9 \times 10^3 \text{ N/m}^2$ (d) $12 \times 10^3 \text{ N/m}^2$

16. * A student has put 8 coins above each other on a horizontal surface as shown in figure (1). If the weight of each coin is 0.08 N and the area of its face is $5.3 \times 10^{-4} \text{ m}^2$, then:



Figure (1)

(i) The pressure of these coins by which they affect the surface equals

- (a) $1.21 \times 10^3 \text{ pascal}$
 (b) $2.41 \times 10^3 \text{ pascal}$
 (c) $5.71 \times 10^3 \text{ pascal}$
 (d) $6.21 \times 10^3 \text{ pascal}$



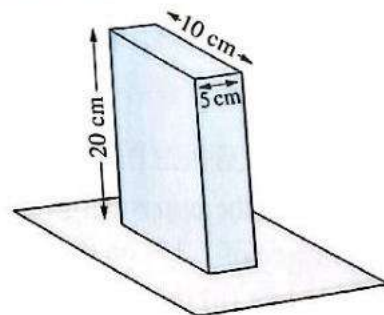
Figure (2)

(ii) If the student spreads the coins on the surface as shown in figure (2), then:

	The total force by which the coins act on the surface	The total pressure by which the coins affect the surface
(a)	Remains constant	Increases
(b)	Remains constant	Decreases
(c)	Decreases	Increases
(d)	Decreases	Doesn't change

* In the opposite figure, a cuboid is placed on a horizontal surface such that the dimensions of its base are (10 cm × 5 cm), so it exerts a pressure of value P on the surface, then how will the pressure on the surface change when the cuboid is repositioned to be on the base of dimensions (20 cm × 10 cm)?

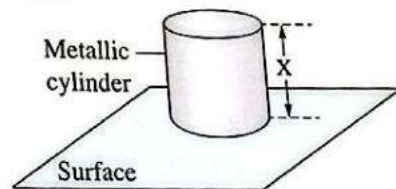
- (a) Increases by $\frac{P}{4}$ (b) Decreases by $\frac{3P}{4}$
 (c) Increases by 4 P (d) Decreases by $\frac{P}{2}$



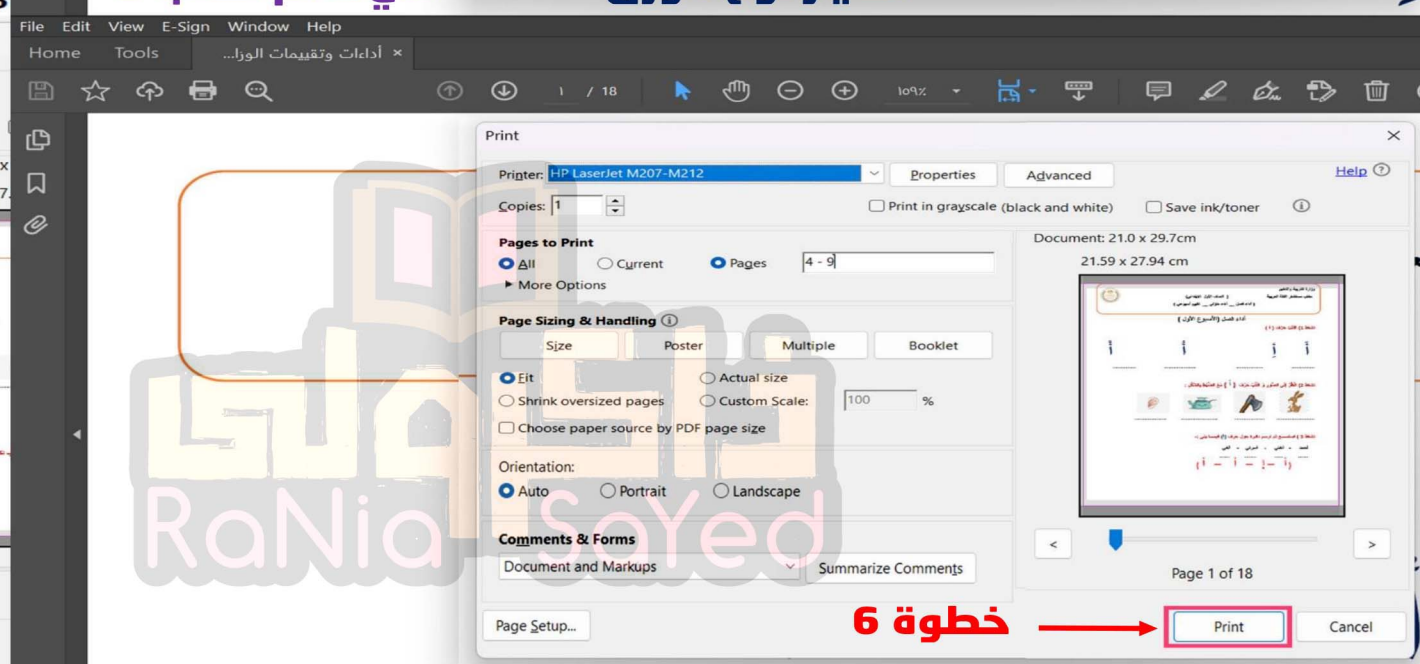
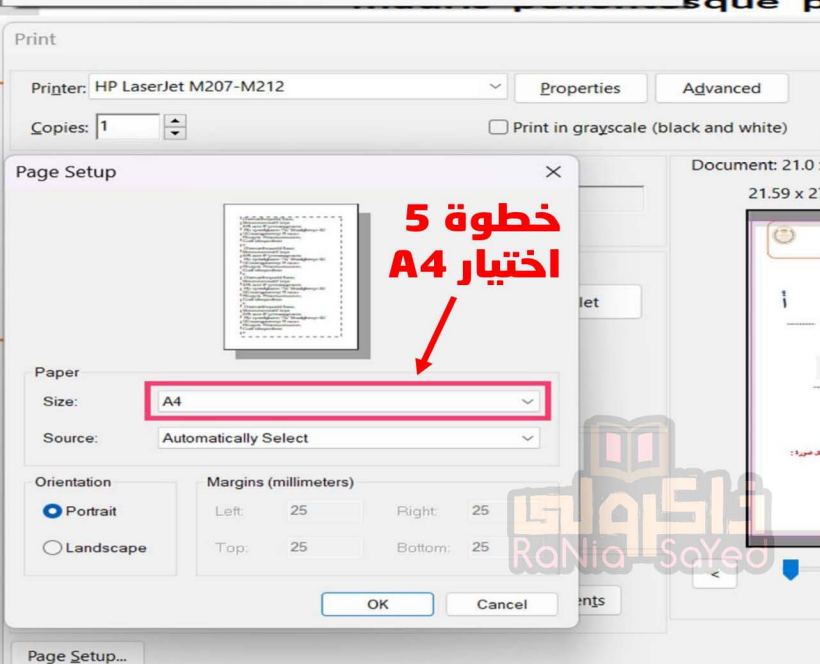
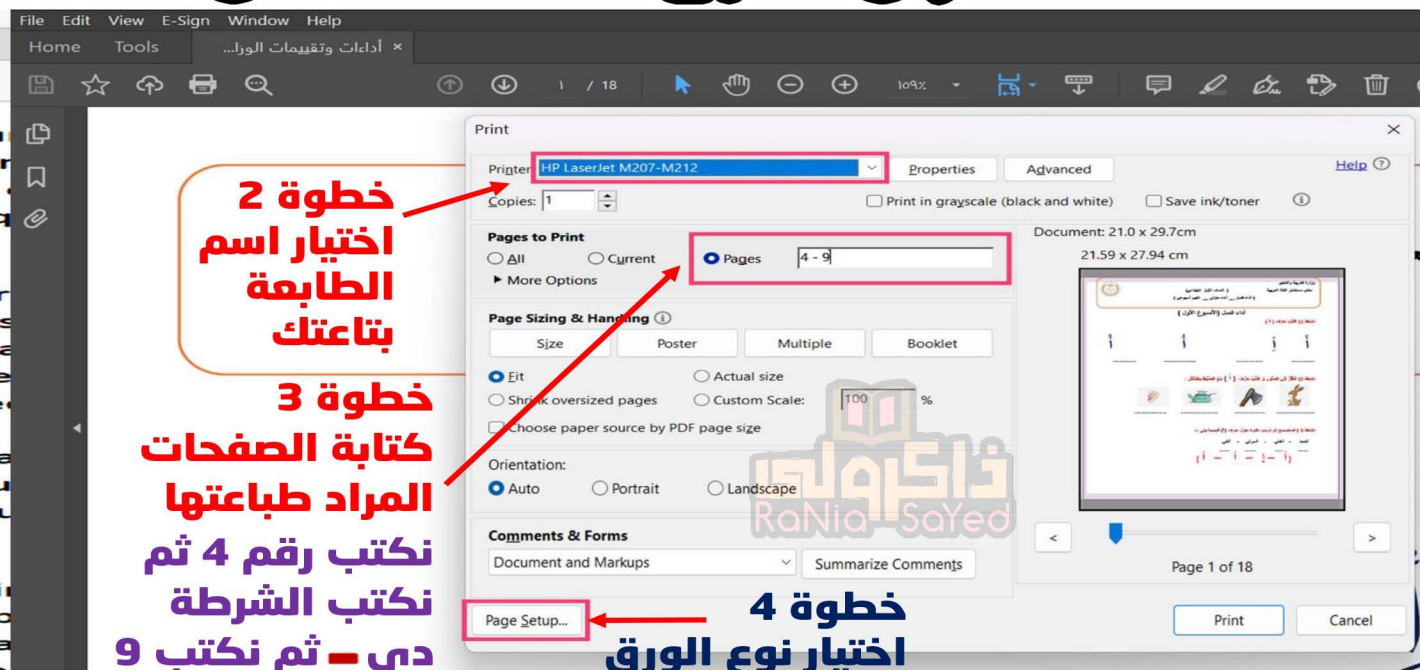
* The opposite figure represents a solid metallic cylinder of height X and cross-sectional area A placed on a horizontal surface. If the cylinder affects the surface by pressure P, the density of the material of the cylinder equals

(Given that the acceleration due to gravity is g)

- (a) $\frac{gX}{P}$ (b) $\frac{P}{gX}$ (c) $\frac{gX}{PA}$ (d) $\frac{PA}{gX}$



كيفية طباعة صفحات معينة من ملف معين مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9



حمل الآن

مجاناً وحصرياً

المراجعة رقم (2)

اختبار شهر نوفمبر





Chapter 3 | Newton's Second Law – Newton's Third Law

First: Multiple Choice Questions

- 1) A car is moving at a speed of **4 m/s**, which increased to **6 m/s** in **2** seconds.

If the mass of the car is **2000 kg**, the force causing this change in speed equals:

- (A) 4000 N (B) 2000 N (C) 5000 N (D) 3000 N

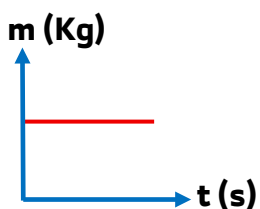
- 2) A car of mass **200 kg** is moving at **4 m/s**. The driver presses the brakes, and the car stops after **2** seconds. The momentum of the car before braking and the force acting on the car are respectively:

- (A) 800 kg·m/s, -200 N (B) 800 kg·m/s, 200 N
(C) 800 kg·m/s, -400 N (D) 800 kg·m/s, 400 N

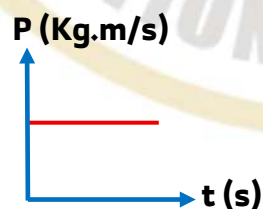
- 3) A force **F₁** acts on a body, causing it to move with uniform acceleration. During its motion, it experiences a frictional force **F₂**. The product of the body's mass × its acceleration equals:

- (A) $F_1 \div F_2$ (B) $F_1 - F_2$ (C) $F_1 + F_2$ (D) $F_2 - F_1$

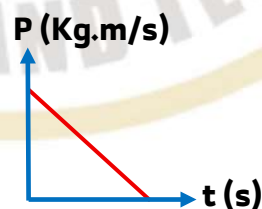
- 4) Which of the following graphs represents a body moving under the effect of frictional force?



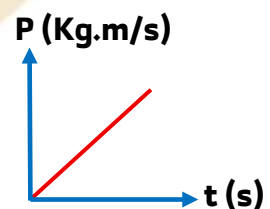
(A)



(B)



(C)

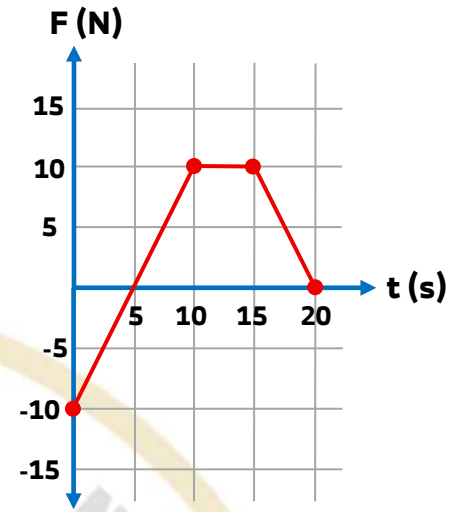


(D)

5) The opposite graph shows the change of the resultant

force acting on a car that started moving from rest, and the time of this change. According to the graph data, the change in momentum during 20 seconds is:

- (A) $-75 \text{ N}\cdot\text{s}$ (B) $75 \text{ N}\cdot\text{s}$
(C) $-125 \text{ N}\cdot\text{s}$ (D) $125 \text{ N}\cdot\text{s}$



6) According to Newton's Third Law, the action and reaction forces:

- (A) act on the same body
(B) are equal in magnitude and have the same direction
(C) act on two different bodies and are equal in magnitude but opposite in direction
(D) act on the same body and have the same magnitude and same direction

7) In the opposite figure, a hockey player hits the ball with his stick.

The action and reaction forces do not cancel each other because:

- (A) the force of the stick on the ball is greater than the force of the ball on the stick
(B) the two forces act on different bodies
(C) the force of the stick on the ball is less than the force of the ball on the stick
(D) the two forces act on the same body



8) In the opposite figure, four books are placed on a table.

Their weights are shown on the figure as 4 N, 5 N, 15 N, and 25 N.

The reaction force of the table on all the books together equals:

- (A) 25 N (B) 49 N (C) 5 N (D) 15 N



9) The acceleration of the body shown equals:

- (A) 0.2 m/s^2 (B) 5 m/s^2 (C) 10 m/s^2 (D) 0

150 N ← 50 Kg → 400 N

10) A force of 300 N acts on a body of mass 30 kg to move it. Neglecting friction, the acceleration gained by the body equals:

- (A) 0.1 N/kg (B) 10 N/kg (C) 100 N/kg (D) 9000 N/kg

11) If a force of 50 N acts on a body of mass 20 kg, the rate of change of velocity of this body equals:

- (A) 2.5 N/kg (B) 2.5 kg/N (C) 2.5 N/kg^{-1} (D) $2.5 \text{ N}^{-1} \cdot \text{kg}$

12) Two cars are moving, and the ratio between their masses is 2 : 1, while the ratio between their accelerations is 2 : 1. The ratio between the resultant forces acting on them is:

- (A) 1:1 (B) 1:2 (C) 4:1 (D) 1:4



Second : Essay Questions

- 13) A car of mass (m) and another car of mass ($2m$) start moving from rest with the same acceleration.

Calculate the ratio between the driving (net) forces acting on the two cars, respectively.

- 14) A force of 1 N acts on a wooden cube and gives it a certain acceleration.

When the same force acts on another cube, it produces an acceleration three times greater than the first case.

Deduce the relationship between the masses of the two cubes.

- The end -

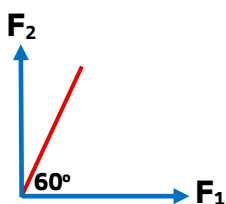


Chapter 3 | Newton's Second Law – Newton's Third Law

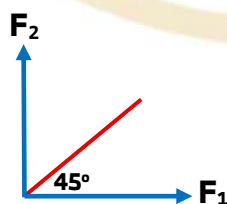
Group (A)

First: Multiple Choice Questions

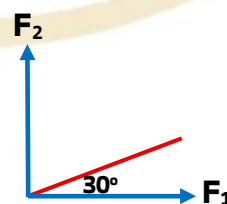
- 1) The mathematical form of Newton's Second Law can be written in all of the following ways except:
- (A) $F = m \Delta v / \Delta t$ (B) $F = ma$ (C) $F = \Delta p / \Delta t$ (D) $F_1 = -F_2$
- 2) A body of mass **2 kg** moves under the action of a **6 N** force, and the frictional force acting on it is **2 N**.
- The acceleration of the body is:
- (A) 6 m/s^2 (B) 2 m/s^2 (C) 3 m/s^2 (D) 4 m/s^2
- 3) According to Newton's Third Law, the correct graphical relationship between the magnitude of the action force (F_1) and the reaction force (F_2), when both are drawn using the same scale, is:



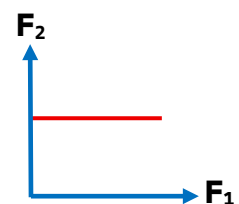
(D)



(C)



(B)



(A)

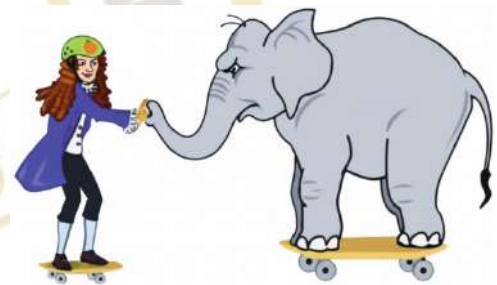
4) The motion of birds during flight is one of the most common examples of which law?

- (A) Newton's First Law (B) The Law of Inertia
(C) Newton's Second Law (D) Newton's Third Law

Second: Essay Questions

5) In the opposite figure, a man is pushing an elephant, and both are standing on movable wooden platforms. As a result, each moves in the opposite direction of the other.

- (1) What is the relationship between the force acting on the elephant and the force acting on the man?
(2) Why are the two forces not balanced?
(3) If the mass of the elephant is **100** times the mass of the man, compare the accelerations of their motions.



Group (B)

First: Multiple Choice Questions

1) The mathematical form of Newton's Third Law can be written in all of the following ways except:

- (A) $m_1 \Delta v_1 / \Delta t = m_2 \Delta v_2 / \Delta t$ (B) $m_1 a_1 = -m_2 a_2$
 (C) $F_1 \Delta v_1 / \Delta t = F_2 \Delta v_2 / \Delta t$ (D) $F_1 = -F_2$

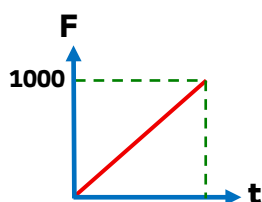
2) A car of mass **15,000 kg** has an engine force of $3 \times 10^4 \text{ N}$ and moves with non-uniform velocity on a rough road.

Its acceleration will be:

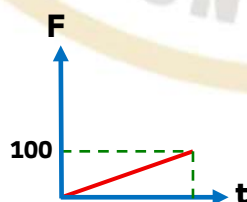
- (A) greater than 2 m/s^2 (B) less than 2 m/s^2 (C) equal to 2 m/s^2 (D) equal to zero

3) A person of mass **70 kg** pushes an elephant of mass **7000 kg**.

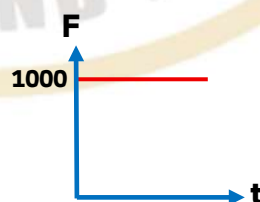
If the person exerts a constant force of 100 N on the elephant, then the elephant exerts on the person a reaction force (**F**) that can be represented graphically by the relation:



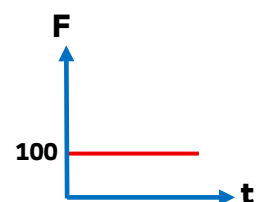
(D)



(C)



(B)



(A)



4) A cannon does not recoil with the same speed as the projectile moves forward because:

- (A) the cannon is fixed in position
- (B) action and reaction forces are opposite in direction
- (C) the inertial masses of the cannon and the projectile are different
- (D) action and reaction are unbalanced forces

Second: Essay Questions

5) In the opposite figure, a man is rowing a boat in a river:

- (1) Identify the action and reaction forces in this situation.
- (2) Explain why the two forces are not balanced.
- (3) If the oars push the water with a force of **50 N**, calculate the acceleration of the boat if its total mass (boat + man) is **250 kg**.



Group (C)

First: Multiple Choice Questions

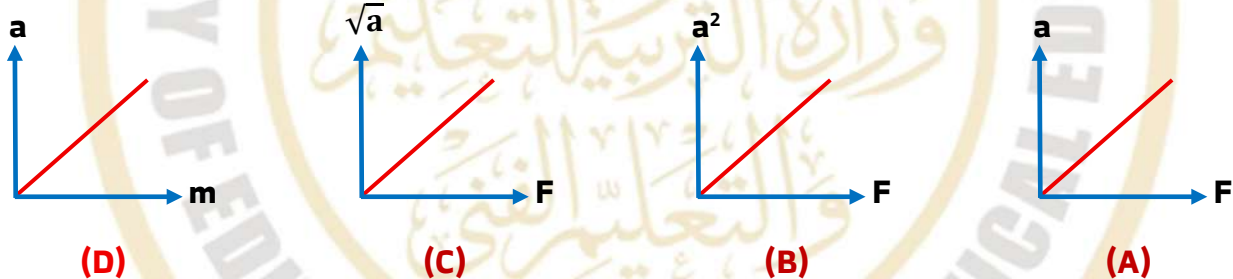
1) The mathematical expression of Newton's Third Law can be written as:

- (A) $F_1 = -F_2$ (B) $F = ma$ (C) $\Sigma F = 0$ (D) $\Sigma F \neq 0$

2) The force required to accelerate a body of mass 10 kg such that its speed changes from **54 km/h to 108 km/h** in **10 seconds** equals:

- (A) 10 N (B) 5 N (C) 15 N (D) 30 N

3) The graphical relationship that correctly represents Newton's Second Law is:



4) In the opposite figure, the force that causes the cart to move forward is:

- (A) the force exerted by the man on the cart
(B) the force exerted by the cart on the man
(C) the force exerted by the ground on the cart
(D) the force exerted by the ground on the man

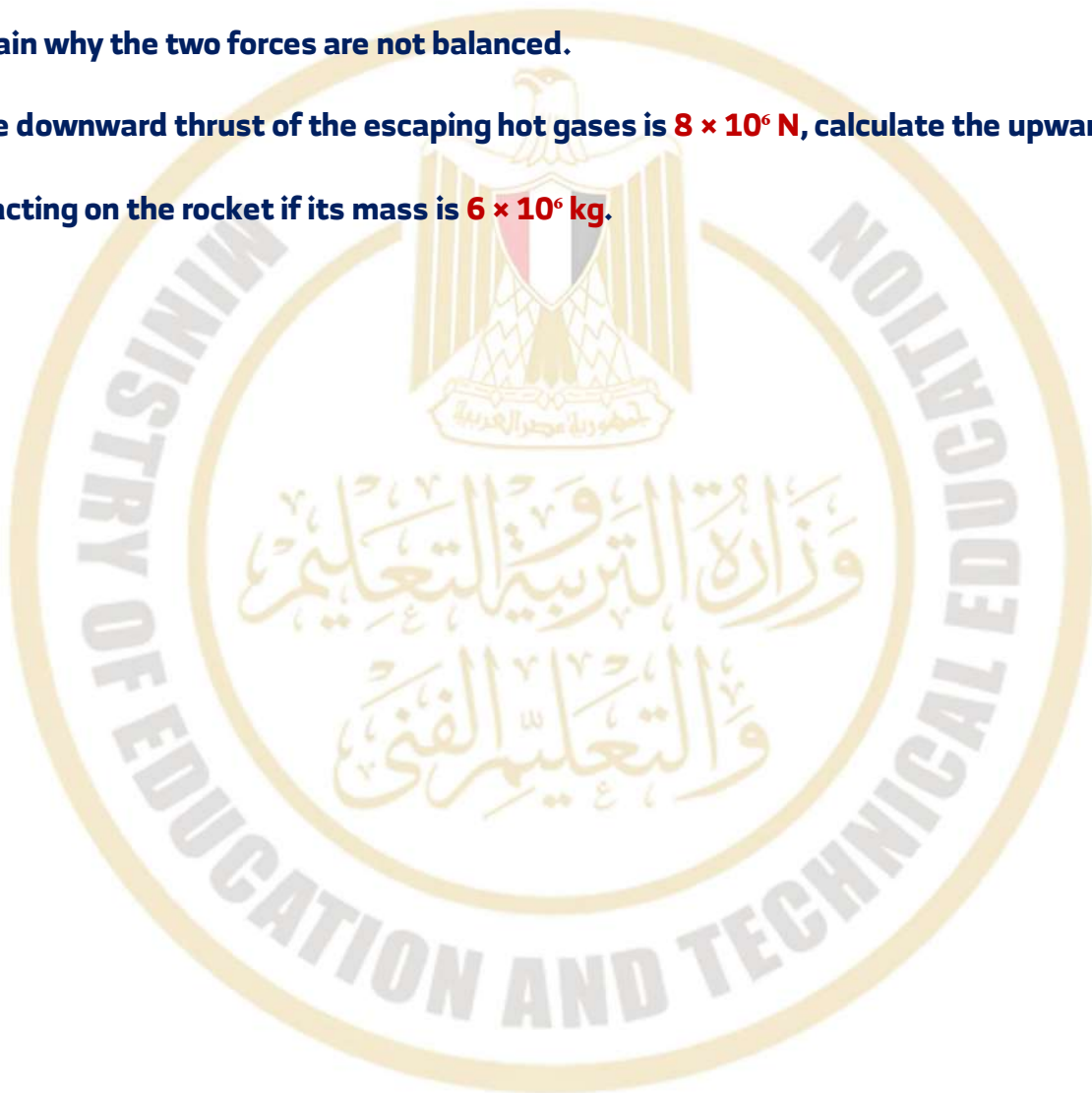


Second: Essay Questions



5) In the opposite figure, a rocket is launched upward:

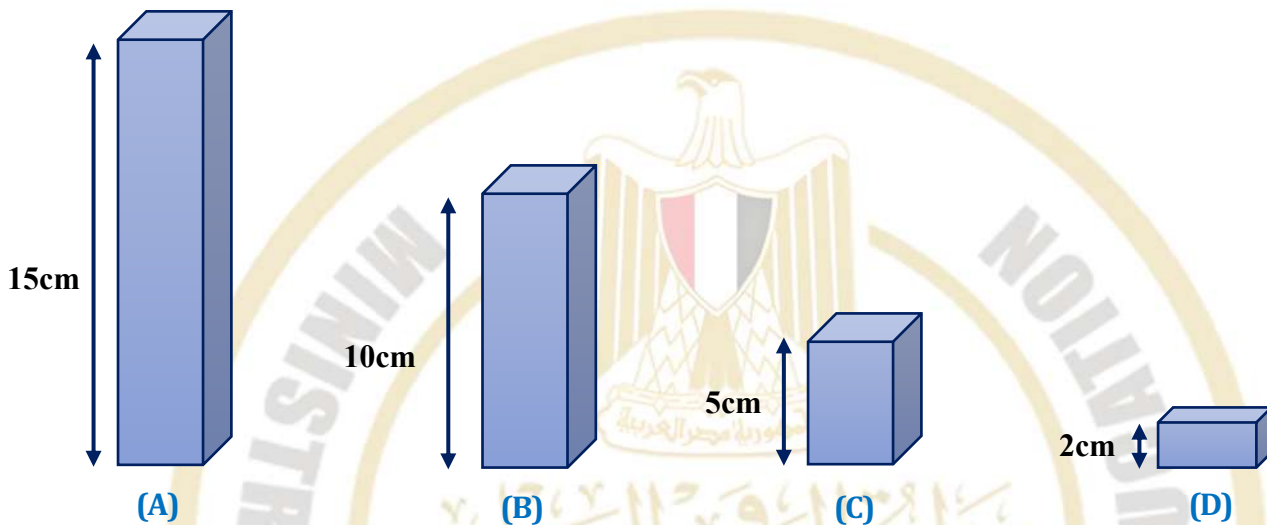
- (1) Identify the action and reaction forces in this situation.
- (2) Explain why the two forces are not balanced.
- (3) If the downward thrust of the escaping hot gases is $8 \times 10^6 \text{ N}$, calculate the upward thrust (force) acting on the rocket if its mass is $6 \times 10^6 \text{ kg}$.



Chapter 4| Density

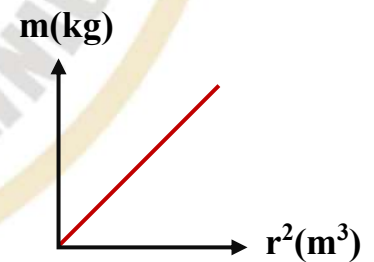
First: Multiple Choice Questions

- 1) The graph shows four blocks, each made of glass with a density of 2.6 g/cm^3 . The base area of each block is 1 cm^2 . Which shape has a mass of 13 g ?



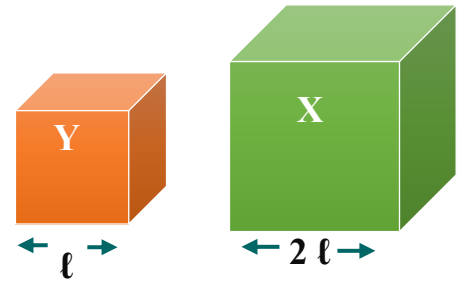
- 2) The graph shows the relationship between the mass (m) and the square of the base radius (r) for a number of solid copper cylinders all of which have the same height (h). The density of copper =

- (A) slope of the graph
- (B) (slope of the graph)/(πh)
- (C) (πh)/(slope of the graph)
- (D) (slope graph)/($\pi^2 h$)



3) In the figure, there are two cubes of different materials with the same mass. The relationship between the density of each of them is

- (A) $\rho_y = 2 \rho_x$
- (B) $\rho_y = 4 \rho_x$
- (C) $\rho_y = 0.5 \rho_x$
- (D) $\rho_y = 8 \rho_x$



4) Two balls (A, B) The mass of ball (A) is three times the mass of ball (B), and its radius is equal to the diameter of ball (B). Then the ratio of the density of ball (A) to the density of ball (B) (ρ_A/ρ_B) is equal to:

- (A) 3/8
- (B) 5/3
- (C) 2/3
- (D) 8/3

5) When measuring the density of equal volumes of different blood samples, if the density of blood for a healthy person is 1060 kg/m^3 and the volume of the blood sample is $2.076 \times 10^{-5} \text{ m}^3$, then the blood sample for a person with anemia is

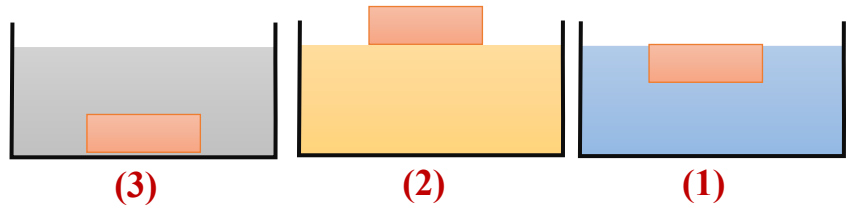
- (A) (1)
- (B) (2)
- (C) (3)
- (D) (4)

Sample	1	2	3	4
Mass (gm)	21	22	23	24

- 6) Three identical copper cubes were placed inside three different liquids as shown in the figure.

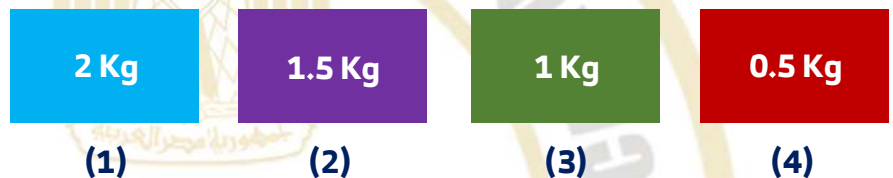
When calculating the density of each liquid, we get

- (A) $\rho_{(1)} > \rho_{(2)} > \rho_{(3)}$
 (B) $\rho_{(3)} > \rho_{(1)} > \rho_{(2)}$
 (C) $\rho_{(1)} > \rho_{(3)} > \rho_{(2)}$
 (D) $\rho_{(2)} > \rho_{(1)} > \rho_{(3)}$



- 7) The opposite figure represents four equal volumes of different objects 1, 2, 3, 4. Which object has the highest relative density?

- (A) (1)
 (B) (2)
 (C) (3)
 (D) (4)



- 8) An empty container has a mass of **10 kg**. When it was completely filled with water, its mass became **17 kg**. Then it was emptied and filled with another liquid, so the mass of the container with the liquid became **20 kg**. The relative density of the liquid is.

- (A) 1.34
 (B) 1.71
 (C) 1.22
 (D) 1.43



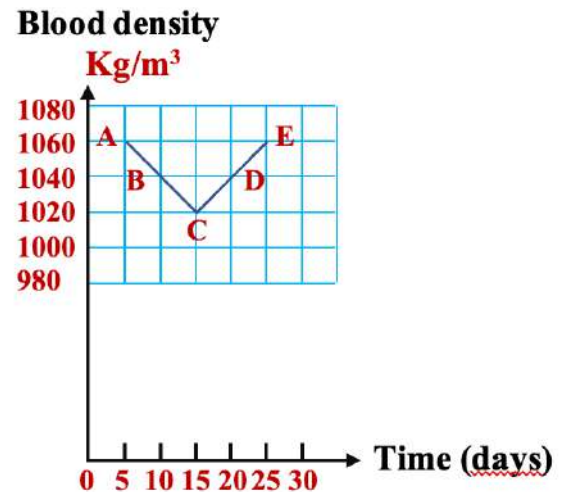
9) In the laboratory for testing the concentration of salts in urine, the results for four people were as follows. Which of the above people has increased salts in the urine?

- (A) Person (D)
- (B) Person (B)
- (C) Person (A)
- (D) Person (C)

Person	A	B	C	D
$(\text{Kg/m}^3)\rho_{\text{urine}}$	1020	1030	1010	1019

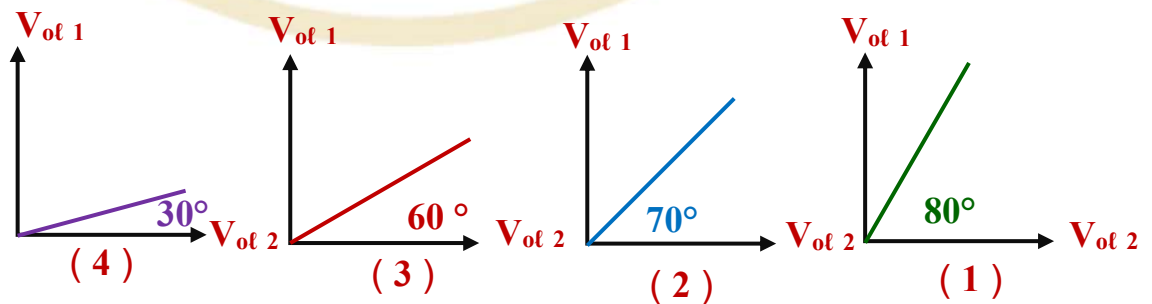
10) The graph shows the variation in blood density of a person under normal observation over a period of 30 days. Which periods indicate that the person is suffering from anemia?"

- (A) AB, DE
- (B) CD, BC
- (C) AB, CD
- (D) BC, DE



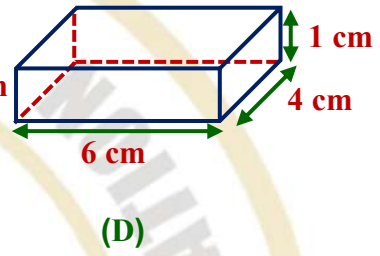
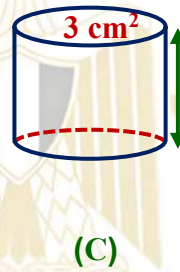
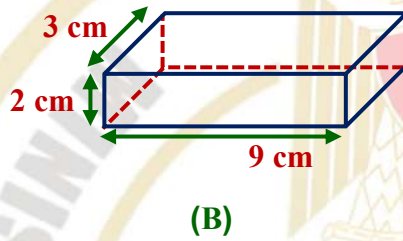
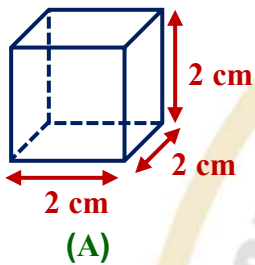
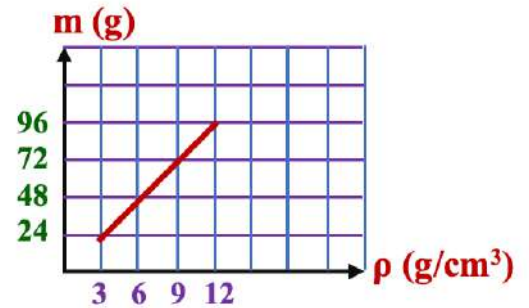
11) You have four graphs that represent the relationship between the volumes of equal masses of different substances (V_{ot1}) and the volumes of the same masses of water (V_{ot2}). The substance with the highest relative density is.....

- (A) 1
- (B) 2
- (C) 3
- (D) 4



12) **The opposite graph:** represents the relationship between mass and density for a number of different materials when the volume is constant. Which of the following graphs represents the volume of one of these materials?

- (A) A
- (B) B
- (C) C
- (D) D



Second: Essay Questions

13) Calculate the density and relative density of aluminum if a volume of 0.1 m^3 has a mass of 270 kg .

14) A cylindrical aluminum container with a thick wall has a mass of 5 kg when empty. Its height is 30 cm and its inner radius is 20 cm . Calculate the mass of the oil that completely fills the container.

Given that:

Density of aluminum = 2700 kg/m^3

Density of oil = 800 kg/m^3

- The end -

**Chapter 4| Density****Group (A)****First: Multiple Choice Questions**

1) The volume of **50 g** of kerosene is **60.9 cm³**. the density and relative density are,, respectively.

(A) 0.82 g/cm³ , 0.82

(B) 0.90 g/cm³ , 0.9

(C) 1.00 g/cm³ , 1

(D) 1.20 g/cm³ , 1.2

2) A container has a mass of **10kg** when empty. When filled with water, its total mass becomes **60kg**, and when filled with oil, its total mass becomes **50kg**.

Given that the density of water is **1000 kg/m³**, the relative density and density of the oil are:

(A) 0.8 and 800 kg/m³

(B) 0.9 and 900 kg/m³

(C) 0.7 and 700 kg/m³

(D) 1.2 and 1200 kg/m³

3) Given that the density of copper = **8700 kg/m³** and the density of water = **1000 kg/m³**, which of the following choices is correct?

	Relative density	Volume	Mass
(A)	8.7	200 cm ³	17.4 kg
(B)	8.7	20 cm ³	0.174 kg
(C)	0.87	2.0 cm ³	1740 kg
(D)	870	0.02 m ³	174 g



- 4) A cube has a side length of **20 cm** and a mass of **76.8 kg**.

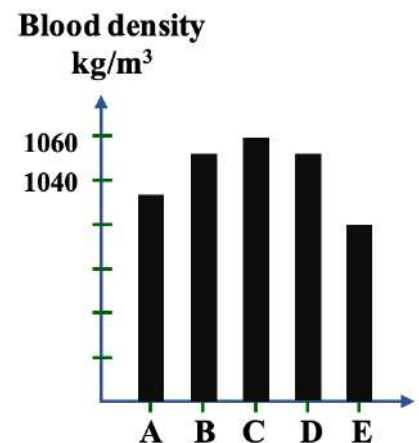
Calculate the density and relative density of the cube, given that the density of water is **1000 kg/m³**.

- (A) 9600 kg/m³ and 9.6
- (B) 900 kg/m³ and 0.9
- (C) 760 kg/m³ and 0.76
- (D) 10,000 kg/m³ and 10

Second: Essay Questions

- 5) The figure shows the blood density of a number of people (**A, B, C, D, E**). The following is true:

- a) The person who is least affected by anemia is
- b) The person who is most affected by anemia is



Group (B)

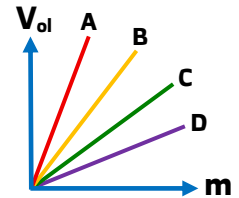
First: Multiple Choice Questions

- 1) Two equal volumes of iron and aluminum have a difference in mass of **12.75 kg**.
If the ratio of their densities (iron: aluminum) is **26/9**, the mass of each metal is:
- (A) Iron = 19.5 kg and Aluminum = 6.75 kg
(B) Iron = 20.8 kg and Aluminum = 8.05 kg
(C) Iron = 26.0 kg and Aluminum = 13.25 kg
(D) Iron = 17.0 kg and Aluminum = 4.25 kg
- 2) A barrel can hold **90 kg** of water or **60 kg** of gasoline. If the density of water is **1000 kg/m³**, then the density and relative density of gasoline, are:
- (A) 667 – 0.667 kg/m³
(B) 0.667 – 667 kg/m³
(C) 0.9 – 900 kg/m³
(D) 0.6 – 600 kg/m³
- 3) Two metallic spheres, the first has a radius (**r**) and density (**ρ**) and the second has a radius (**2r**) and density (**2 ρ**). The ratio between their masses equals
- (A) 1/4
(B) 1/2
(C) 1/8
(D) 1/16
- 

Ball (2) Ball (1)

4) The following graph shows the relationship between volume and mass for several solid pieces made of different materials. The correct relationship expressing the densities of the materials is:

- (A) $\rho_A > \rho_B > \rho_C > \rho_D$
- (B) $\rho_D > \rho_C > \rho_B > \rho_A$
- (C) $\rho_A = \rho_B = \rho_C = \rho_D$
- (D) $\rho_A = \rho_B > \rho_C = \rho_D$



Second: Essay Questions

5) A cube of iron has a side length of **12 cm** and a mass of **7 kg**. Given that the density of iron = **7800 kg/m³**, determine whether this cube is solid or contains cavities (air gaps). Explain your answer.

Group (C)

1) An empty container has a mass of **190 g**.
When filled with a liquid of relative density **0.81**, the total mass of the container and the liquid becomes **400 g**.
If the same container is filled with water (density = **1 g/cm³**), the total mass of the container and the water will be approximately:

- (A) 299 g
- (B) 349 g
- (C) 399 g
- (D) 449 g

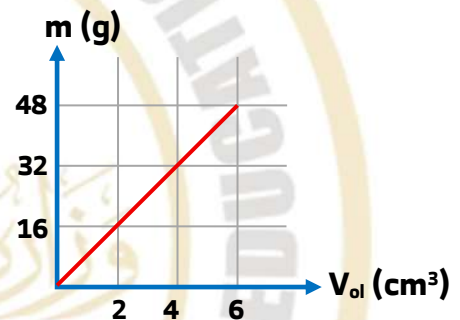
2) The ratio of the density of the electrolyte solution in a car battery after the battery is discharged to its density after the battery is recharged is:

- (A) Greater than one
- (B) Less than one
- (C) Equal to one
- (D) May be greater or less than one

3) The following graph: shows the relationship between the masses of several pieces of a certain metal and their volumes.

Given that the density of water = 1000 kg/m^3 , the relative density of the metal equals:

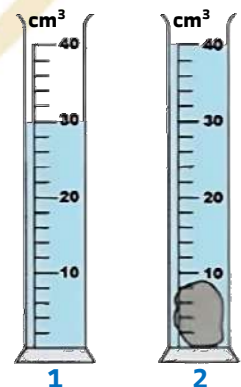
- (A) 8000
- (B) 1000
- (C) 8
- (D) 1



4) Figure (1) shows a graduated cylinder containing a certain amount of water, while Figure (2) shows the same cylinder after adding a metal piece of mass 25 g.

The density of the metal equals:

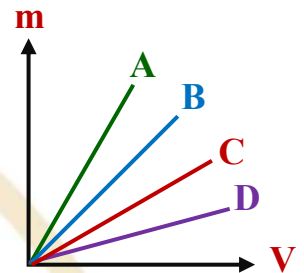
- (A) 2500 g/cm^3
- (B) 2.5 kg/m^3
- (C) 2500 kg/m^3
- (D) 2.5 g/cm^3



Second: Essay Questions

5) The following graph shows the relationship between the mass and volume of a quantity of blood for four persons suffering from anemia.

Which of these persons has the highest level of anemia? Explain your answer.



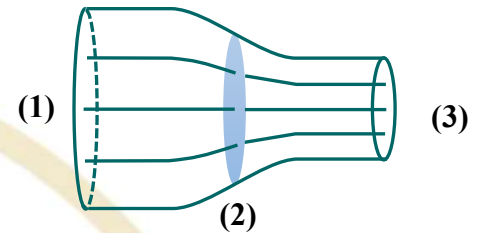
- The end -

Chapter 4| Hydrodynamics

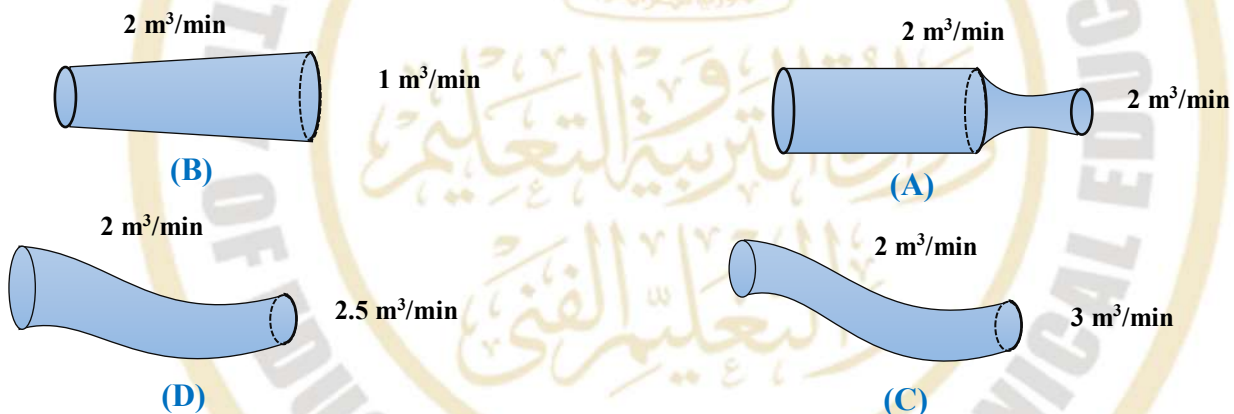
First: Multiple Choice Questions

1) The figure shows a flow tube through which the liquid flows in a laminar (**streamline**) flow. Then:

- (A) The mass flow rate at (1) has the greatest value
- (B) The mass flow rate at (2) has the greatest value
- (C) The mass flow rate at (3) has the greatest value
- (D) The mass flow rates are equal at all points



2) From the figures given, determine which one represents **laminar flow**?





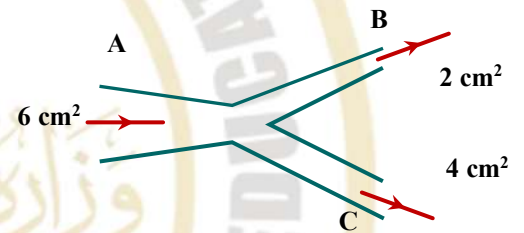
3) In **steady flow** of liquids, the ratio between the number of streamlines passing through the wide section of the tube to the number of streamlines passing through the narrow section of the same tube equals

- (A) Greater than one
- (B) Equal to one
- (C) Less than one
- (D) Equal zero

4) In the adjacent figure represents a tube with water flowing in **steady flow**:

If the velocity of water at **A** and **C** is **8 m/s** and **4 m/s** respectively, then its velocity at **B** is:

- (A) 6 m/s
- (B) 8 m/s
- (C) 12 m/s
- (D) 16 m/s



5) A liquid flows through a tube of uniform diameter (**X**) with velocity (**v**). If a cork stopper is placed at the end of the tube, and the diameter of the hole in the cork is equal to **X/4**, then the velocity of the liquid emerging through the hole in the cork equals

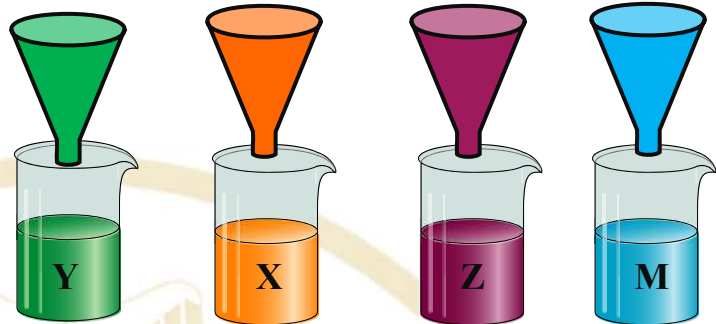
- (A) $16 v$
- (B) $4 v$
- (C) $1/4 v$
- (D) $1/16 v$

6) The figure shows equal quantities of different liquids poured into identical funnels.

Given that viscosity: $M > Z > X > Y$

Which liquid collects in the container first?

- (A) Liquid M
- (B) Liquid Y
- (C) Liquid X
- (D) Liquid Z

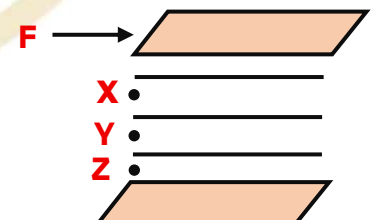


7) Can water be used for lubricating metallic machines?

- (A) Yes, because it is a low-cost liquid and it cools the machine parts.
- (B) No, because its viscosity is low and it causes corrosion of metals.
- (C) Yes, because it adheres to the machine parts, fully covering and protecting them from corrosion.
- (D) No, because liquid water cannot be used for cooling metals.

8) A liquid is confined between two parallel plates. A tangential force is applied to the upper plate to move it, so the **velocity** of the points shown in the figure will be as follows:

- (A) $V_Z < V_Y < V_X$
- (B) $V_Z = V_Y = V_X$
- (C) $V_Z < V_Y = V_X$
- (D) $V_Z > V_Y > V_X$



- 9) Four identical metallic balls are fallen down from the same height, each ball toward a separate jar where each jar contains a different liquid from the other jars then the taken time by each ball to reach the bottom of the jar is recorded in each case as the following:

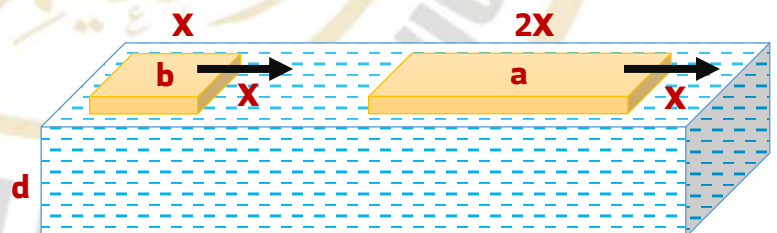
The jar	The time taken by the ball to reach the bottom
1	0.2 s
2	0.3 s
3	0.6 s
4	1 s

Which jar contains the liquid with **higher** viscosity?

- (A) Jar 1
- (B) Jar 2
- (C) Jar 3
- (D) Jar 4

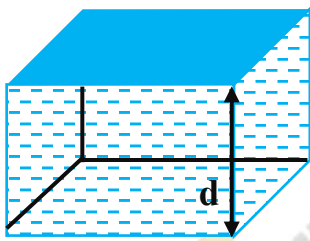
- 10) Two plates, **a** and **b** move on the surface of a liquid with the same velocity. The ratio between the forces F_a/F_b is equal to the ratio:

- (A) 2/1
- (B) 1/1
- (C) 4/1
- (D) 1/2

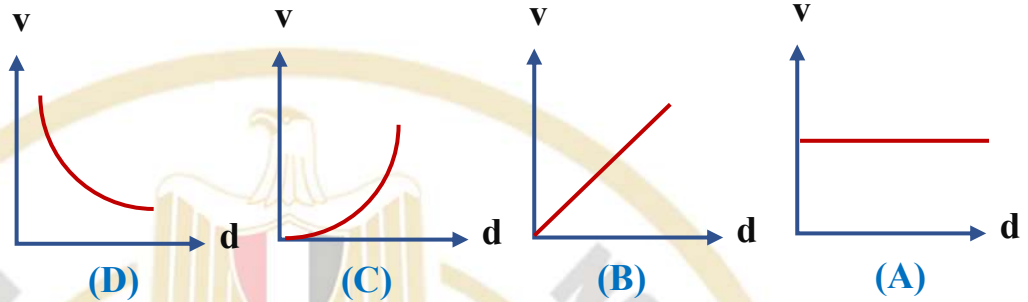


- 11) The figure represents a sample of a liquid confined between two plates: the lower plate (**stationary**) and the upper plate (**moving**). Which of the following graphs represents the relationship between the velocity of flow of each liquid layer (**v**) and the depth of that layer (**d**)?

The upper plate (moving)



The lower plate (stationary)



Second: Essay Questions

- 12) Three taps are used to fill a tank. the first fills the tank in **1 hour**, the second fills the tank in **1/2 hour** and the third fills the tank in **1/4 hour**. Calculate the time required to fill the tank if all three taps are opened at the same moment.
- 13) A main artery of an adult person has a cross-sectional area of **3 cm²** and a blood flow velocity of **30 cm/s**. The blood is distributed into a number of capillaries, each having a cross-sectional area of **3×10⁻⁵ m²** and a velocity of **0.05 cm/s**. Calculate the number of capillaries.

**Chapter 4| Hydrodynamics****Group (A)****First: Multiple Choice Questions**

- 1) A tube of diameter **10 cm** ends with a diameter **2.5 cm**. If the velocity of water in the wide section of the tube is **1 m/s**.

Given that the density of water is **1000 kg/m³**

	The velocity of water at the end.	The mass of water flowing per minute through any cross-section of the tube.
(A)	4 m/s	118 kg
(B)	8 m/s	235 kg
(C)	16 m/s	472 kg
(D)	25 m/s	785 kg

- 2) In a **steady flow**, if the radius of a tube is doubled, the mass flow rate

- (A) Doubles
- (B) decreases to a quarter
- (C) remains constant
- (D) decreases to half



- 3) If the cross-sectional area of a tube in which a liquid flows steady increases to double, the volume flow rate
- (A) Doubles
 - (B) decreases to a quarter
 - (C) remains constant
 - (D) decreases to half
- 4) When measuring the speed of a liquid in a pipe, the value of the speed at a certain point at that moment was **8 m/s**, and at another moment at the same point the speed became **9 m/s**, then the type of flow is
- (A) Turbulent flow
 - (B) Steady flow
 - (C) Steady then turbulent flow
 - (D) Turbulent then steady flow

Second: Essay Questions

- 5) In human body, why is the speed of flow of blood in the major artery **greater than** its speed in blood capillaries although the area of capillary is less than the area of artery?

Group (B)

First: Multiple Choice Questions

- 1) The ratio between the sedimentation rate of red blood cells in **anemia** patients and in **rheumatic fever** patients is
- (A) Less than one
(B) Equal one
(C) Greater than one
(D) less or greater than one
- 2) Water flows steadily through a pipe of radius **4 cm** with a speed of **2 m/s**.
The volume of the liquid that flows in one minute is m^3
- (A) 0.151
(B) 0.302
(C) 0.452
(D) 0.603
- 3) If you know that the volume flow rate of a liquid is **$2 \times 10^2 \text{ m}^3/\text{s}$** and the mass flow rate is **$2 \times 10^5 \text{ kg/s}$** , then its density is kg/m^3
- (A) 500
(B) 750
(C) 1000
(D) 1500



- 4) You have four wooden plates of different areas where $A_1 > A_2 > A_3 > A_4$.

They are placed on the surface of the same liquid, and each is to be moved with the same speed.

If the depth of the liquid is the same, which of the following represents the correct order of the force required to move them?

- (A) $F_1 > F_2 > F_4 > F_3$
(B) $F_1 > F_4 > F_2 > F_3$
(C) $F_1 > F_3 > F_2 > F_4$
(D) $F_1 > F_2 > F_3 > F_4$

Second: Essay Questions

- 5) A surface layer of a liquid of area 2 m^2 moves with a velocity of 2 m/s due to the action of a tangential force of 4 N , while the stationary layer of the liquid lies at a depth of 2 cm below the surface.

Calculate:

- (a) The coefficient of viscosity of the liquid.
(b) The force required for the moving layer to reach double the speed.

Group (C)

1) A certain mass flow rate of two different liquids passes through two flow tubes.

The ratio of their densities is $1/4$, and the volume of the first liquid is twice that of the second. If the mass flow rate is constant, then the ratio t_1/t_2

- (A) $1/2$
- (B) $2/1$
- (C) $1/4$
- (D) $4/1$

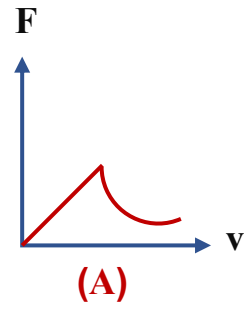
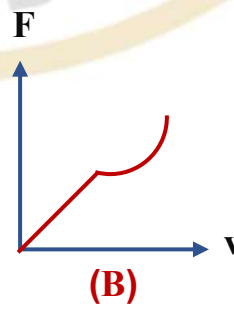
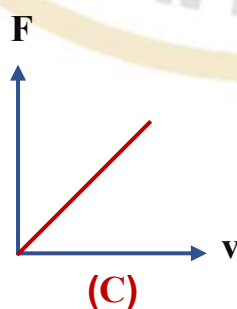
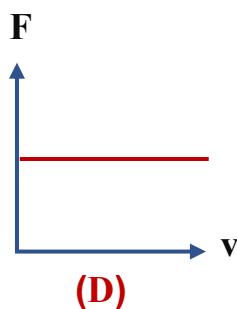
2) When performing an erythrocyte sedimentation rate (ESR) test for three persons. The first suffering from **rheumatic fever**, the second from **anemia**, and the third being **healthy**. the final sedimentation rate of the red blood cells will be:

- (A) Equal in all three persons
- (B) Greatest in the second person
- (C) Greatest in the first person
- (D) Greatest in the third person

3) A car starts from rest and its speed increases until it exceeds 120 km/h .



Which of the following graphs correctly represents the relationship between speed and air resistance?





4) A liquid flows through a tube with a speed v .

If its speed increases to $2v$, the ratio r_2/r_1 is

- (A) $1/2$
- (B) $\sqrt{2}/1$
- (C) $2/1$
- (D) $1/\sqrt{2}$

Second: Essay Questions

5) A circular plate of diameter 140 cm slides with a speed of 0.1 m/s on a layer of viscous liquid of thickness 2.5 mm and coefficient of viscosity $2.5 \text{ kg/(m}\cdot\text{s)}$.

Calculate the tangential force acting on the plate.

(Given that $\pi = 22/7$)

- The end -

Chapter 4| Pressure

First: Multiple Choice Questions

1) If you know that the unit of force is **the newton** and it is equal to **kg. m/s²**. Which of the following units is used to measure **pressure**?

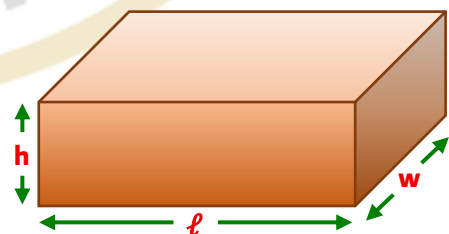
- (A) kg . m⁻². s⁻¹
- (B) kg . m⁻². s⁻²
- (C) kg . m⁻¹. s⁻²
- (D) kg . m⁻¹.s⁻¹

2) A tangential force of **200 N** affected the upper surface of a cube with a side length of **10 cm**. The resulting pressure is equal to

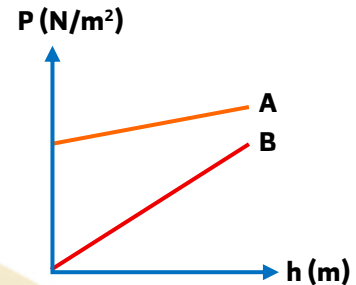
- (A) $2 \times 10^4 \text{ N/m}^2$
- (B) $2 \times 10^5 \text{ N/m}^2$
- (C) $2 \times 10^3 \text{ N/m}^2$
- (D) Zero

3) A cuboid with dimensions (**ℓ**, **w**, **h**) is placed on a horizontal surface as shown in the figure. The maximum pressure exerted on the surface can be calculated from the relationship

- (A) $P_{\max} = F_g/(w.h)$
- (B) $P_{\max} = \rho.w.g$
- (C) $P_{\max} = F_g/(L.w)$
- (D) $P_{\max} = \rho.h.g$

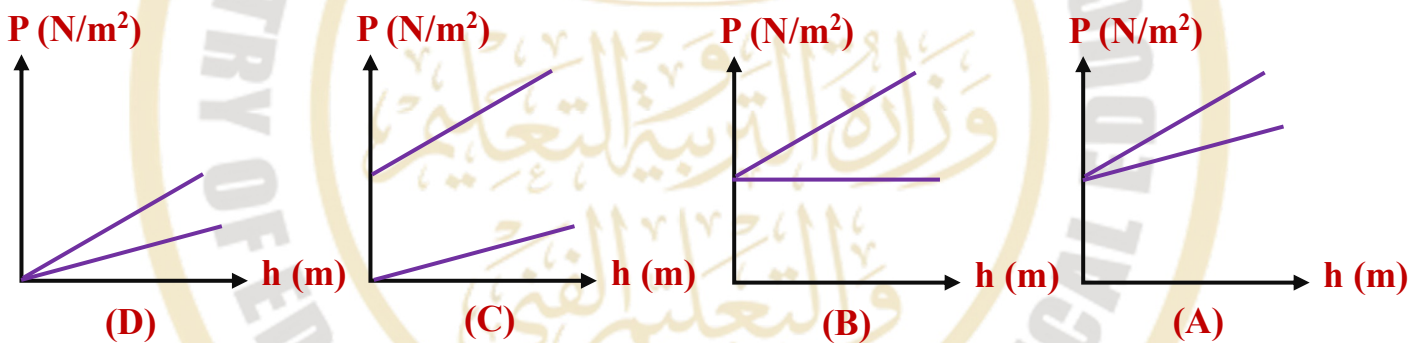


- 4) The graph represents the relationship between the pressure at a point in the two different fluids **A**, **B** and the depth of this point in the fluids. Which of the following choices is correct?

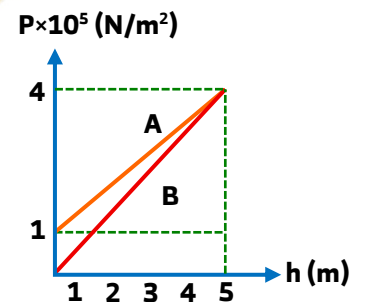


- (A) $\rho(A) > \rho(B)$, A is exposed to air .
 (B) $\rho(A) > \rho(B)$, A is not exposed to air
 (C) $\rho(A) < \rho(B)$, A is exposed to air
 (D) $\rho(A) < \rho(B)$, A is not exposed to air

- 5) Two identical tanks containing two liquids. The density of the liquid in the second tank is **greater than** the density of the liquid in the first tank. The first tank is closed and the second tank is open. The graph shows the pressure (**P**) and the depth (**h**). The ...



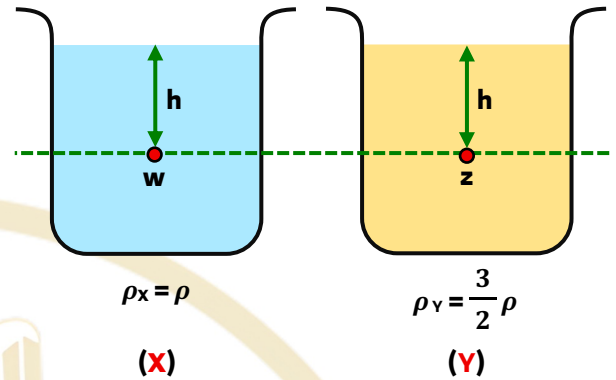
- 6) In the given graph: **A** and **B** are two different liquids. The ratio between density of liquid **B** and density of liquid **A** is:



- (A) 5/4
 (B) 4/5
 (C) 4/3
 (D) 3/4

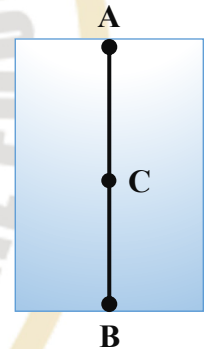
7) Two identical tanks containing two liquids (X, Y) of different densities, the relationship between the pressure at (w) and the pressure at (z) on the same horizontal level is

- (A) $P_w = P_z$
- (B) $3P_w = 2P_z$
- (C) $2P_w = 3P_z$
- (D) $P_w = 1/2 P_z$



8) The figure represents a part of the fluid pressure at point A located at the surface is R where R represents the atmospheric pressure and the pressure difference between A, B is equal to 3R, and point C is located in the middle of the vertical distance between A, B. The value of the pressure at point C is equal to.

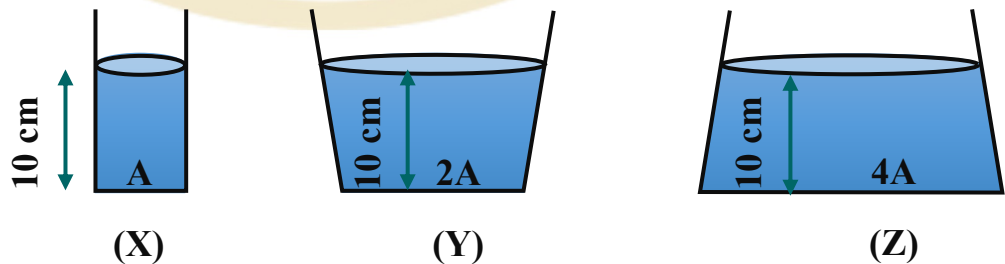
- (A) $(5 R)/2$
- (B) $(3 R)/2$
- (C) $3 R$
- (D) $2 R$



9) In the figure shown, three vessels are filled with water.

The ratio of the force of the water on the base is, in the order $F_X: F_Y: F_Z$, which is

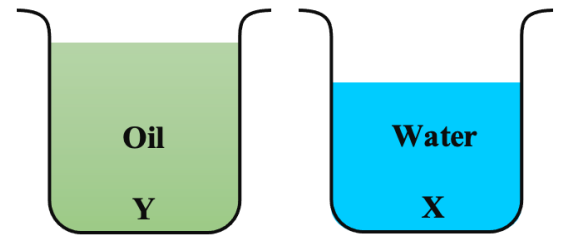
- (A) 10: 20: 15
- (B) 4: 2: 1
- (C) 1: 2: 2
- (D) 1: 2: 4



- 10) Two identical tanks, each with a cross-sectional area of A , fill the first with water and the volume of water is **0.6** of the volume of the tank, and fill the second with oil and the volume of oil is **0.7** of the volume of the tank. The ratio between (water pressure at point **X**)/ (oil pressure at point **Y**) is:

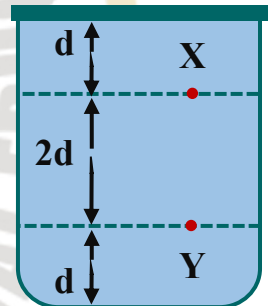
(Knowing that the $\rho_w = 1000 \text{ Kg/m}^3$ and $\rho_{oil} = 800 \text{ Kg/m}^3$)

- (A) 4/5
- (B) 2/25
- (C) 5/4
- (D) 15/14



- 11) In the given figure, a tank is filled with a certain liquid. If the pressure of the liquid at point (**X**) is **3** bar, then the pressure at point (**Y**) is

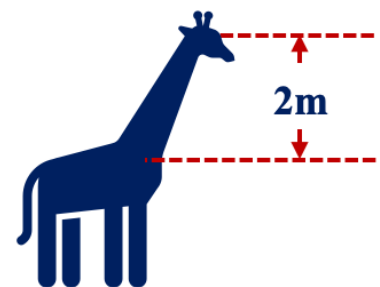
- (A) 9 bar
- (B) 4.5 bar
- (C) 6 bar
- (D) 12 bar



Second: Essay Questions

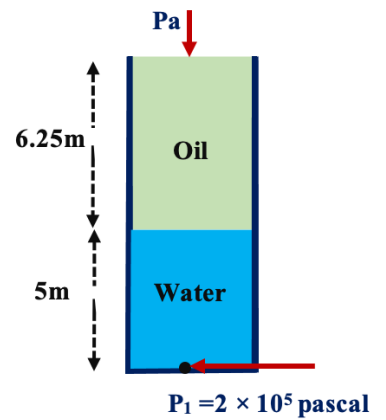
- 12) What is the pressure difference between the heart and the brain in a giraffe, if the brain is **2m** above the heart?

(Blood density **1060 kg/m³**, assuming constant blood velocity)



13) From the opposite figure, Calculate the pressure on the surface of the oil

Knowing that $\rho_{oil} = 800 \text{ Kg/m}^3$, $g = 10 \text{ m/s}^2$, $\rho_w = 1000 \text{ Kg/m}^3$.



14) A tank with dimensions $200 \text{ cm} \times 100 \text{ cm} \times 50 \text{ cm}$ is filled with water up to a height of 2 m . Calculate:

- The pressure of the water on the bottom of the tank.
- The force exerted by the water on the bottom of the tank.
- The pressure of the water at a point 40 cm above the bottom.

-The end-

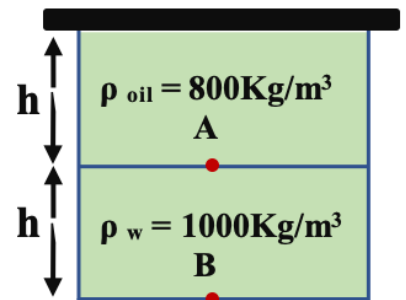
Chapter 4| Pressure

Group (A)

First: Multiple Choice Questions

- 1) A vessel contains a quantity of water and oil. The ratio between Pressure at point **A** and Pressure at point **B** is

- (A) 4/6
(B) 4/8
(C) 9/10
(D) 4/9



- 2) A wooden table has a top surface with dimensions **1.6 m × 2 m**. Calculate the force exerted by atmospheric pressure on the table's surface.

(Knowing that $P_a = 1.03 \times 10^5 \text{ N/m}^2$)

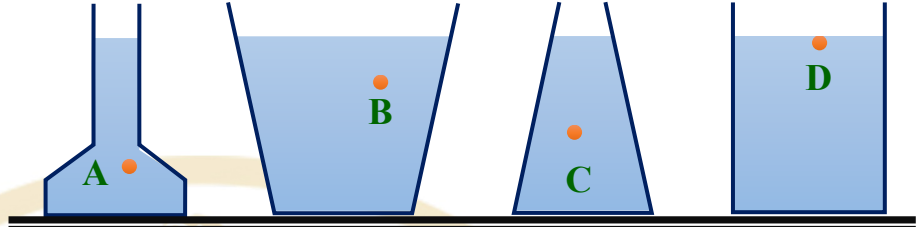
- (A) $1.013 \times 10^5 \text{ N}$
(B) $3.24 \times 10^5 \text{ N}$
(C) $0.317 \times 10^5 \text{ N}$
(D) $3.24 \times 10^5 \text{ N}$



3) A set of containers is filled with water as shown in the figure.

Which of the following represents the correct order of pressure at points A, B, C, and D?

- (A) $P_A > P_B > P_C > P_D$
- (B) $P_D > P_C > P_B > P_A$
- (C) $P_A > P_C > P_B > P_D$
- (D) $P_D > P_B > P_C > P_A$



4) A person is diving in a liquid with a density of 1030 kg/m^3 .

The maximum pressure that can be tolerated without eardrum rupture is $30.6 \times 10^4 \text{ N/m}^2$.

Given that atmospheric pressure (P_a) = $1.013 \times 10^5 \text{ N/m}^2$ and $g = 9.8 \text{ m/s}^2$,

the maximum depth the diver can reach is:

- (A) 10.11 m
- (B) 30.32 m
- (C) 20.28 m
- (D) 40.35 m

Second: Essay Questions

5) A solid cube and a solid rectangular block are made of the same material. The dimensions of the rectangular block are $(10 \text{ cm} \times 20 \text{ cm} \times 30 \text{ cm})$. When the block is placed on a table resting on the face $(20 \text{ cm} \times 30 \text{ cm})$, the pressure it exerts is three times the pressure exerted by the cube when placed on the same table. Calculate the side length of the cube.

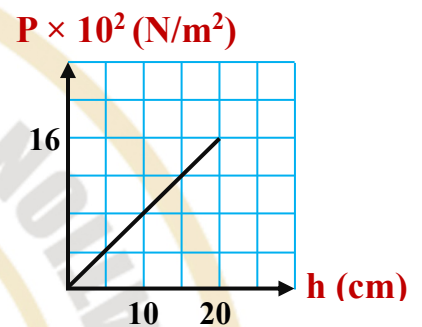
Group (B)

First: Multiple Choice Questions

- 1) The figure shows the relationship between the pressure at several points within the liquid and their depths.

Given that the acceleration due to gravity is $g = 10 \text{ m/s}^2$, the density of the liquid is:

- (A) 800 kg/m^3
(B) 0.8 kg/m^3
(C) 8000 kg/m^3
(D) 0.16 kg/m^3

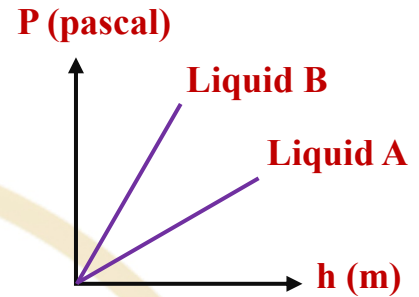


- 2) Two bodies (A, B) are placed at two different depths (15 cm, 20 cm) respectively in a closed container filled with water. The ratio between the pressure exerted on body B and the pressure exerted on body A is equal to

- (A) $4/3$
(B) $3/4$
(C) $5/4$
(D) $4/5$

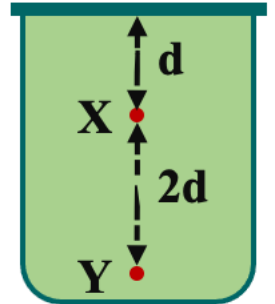
- 3) The graph shows the relationship between the pressure of two different liquids and the height of the liquid column (**h**) for two separate experiments. If the slope of straight-line **A** = **7900** and the slope of straight-line **B** = **9800**. Which of the following choices is correct?

- (A) $\rho_B > \rho_A$
 (B) $\rho_A = 2\rho_B$
 (C) $\rho_A = 9.8 \rho_B$
 (D) $\rho_B = \rho_A$



- 4) A container holds a liquid, The ratio of the pressure at point **X** to the pressure at point **Y** is:

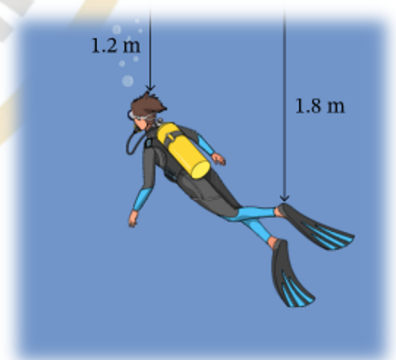
- (A) 2/1
 (B) 1/3
 (C) 1/2
 (D) 1/1



Second: Essay Questions

- 5) A diver swims in water with a density of **1015** kg/m³, as shown in the figure.

Calculate the difference in water pressure between the diver's head and feet.

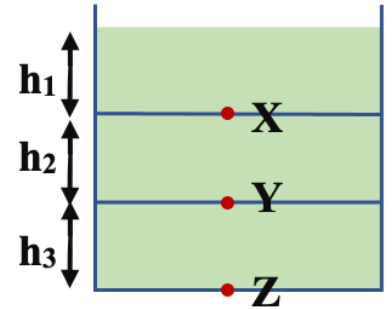


Group (C)

- 1) The figure shows containers filled with a liquid of density ρ , under gravitational acceleration g , and liquid heights $h_1 = h_2 = h_3$.

The pressures at points **X**, **Y**, and **Z** are:

- (A) $P_x > P_y > P_z$
- (B) $P_x = 3 P_z = 2 P_y$
- (C) $P_z > P_y > P_x$
- (D) $P_y = 2 P_z = 3 P_x$



- 2) At a point inside a liquid, the pressure:

- A) Acts only in the downward direction
- B) Acts equally in all directions and increases with depth
- C) Acts parallel to the surface of the liquid
- D) Decreases with the depth of the liquid

- 3) A submarine is designed to withstand a maximum pressure of $12.2 \times 10^5 \text{ N/m}^2$.

If the density of seawater is 1030 kg/m^3 , what is the maximum depth it can safely dive to?

Also, if the diameter of its hatch is 100 cm , what is the force acting on the hatch at that depth? (Take $g = 9.8 \text{ m/s}^2$)

- (A) Depth = 121 m , Force = $3.8 \times 10^6 \text{ N}$
- (B) Depth = 121 km , Force = $9.6 \times 10^5 \text{ N}$
- (C) Depth = 121 m , Force = $9.6 \times 10^5 \text{ N}$
- (D) Depth = 121 km , Force = $3.8 \times 10^6 \text{ N}$

- 4) A beaker contains mercury to a height of **5 cm**, above which there is a layer of water **10 cm** high, and on top of that, a layer of kerosene **2 cm** high.

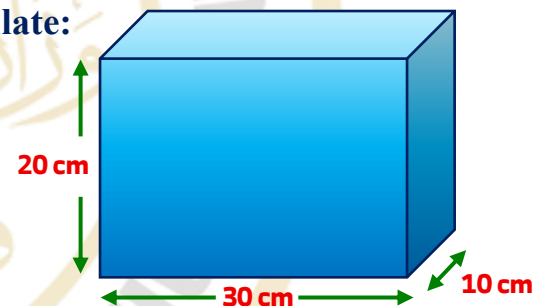
Given that the densities of mercury, water, and kerosene are **13600 kg/m³**, **1000 kg/m³**, and **800 kg/m³** respectively, and the acceleration due to gravity is $g = 9.8 \text{ m/s}^2$. The total pressure exerted by all the liquids on the bottom of the beaker is

- (A) $7.81 \times 10^3 \text{ N/m}^2$
 (B) $7.5 \times 10^3 \text{ N/m}^2$
 (C) $8 \times 10^3 \text{ N/m}^2$
 (D) $9.20 \times 10^3 \text{ N/m}^2$

Second: Essay Questions

- 5) A rectangular block has dimensions **25 cm × 20 cm × 10 cm** and a density of **2700 kg/m³**. It is placed on a horizontal table as shown. Calculate:

- (a) The pressure exerted by the block.
 (b) The maximum pressure that the block can exert.
 (c) How should the block be placed to produce the maximum pressure?



حمل الآن

مجاناً وحصرياً

المراجعة رقم (3)

اختبار شهر نوفمبر



Fluids

They are the materials which can flow and have indefinite shape.

★ Types of fluids:

1-Liquids which are characterized by:

-Definite volume -smooth flow -Incompressible

2- Gases which are characterized by:

-Occupying any space and take the volume of its container.

-Can be easily compressed.

★ From properties of fluids:

1-Density

2-Pressure

Density

It is the mass of unit volume of a substance.

$$\text{Density}(\rho) = \frac{\text{mass}(m)}{\text{volume}(V_{ol})}$$

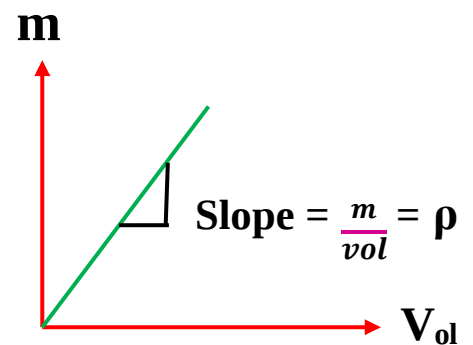
-The measuring unit is (kg/m³).

*Some conversions

$$* \text{ g/cm}^3 \times 10^3 \rightarrow \text{kg/m}^3$$

$$* \text{ Liter} \times 10^{-3} \rightarrow \text{m}^3$$

$$* \text{ cm}^3 \times 10^{-6} \rightarrow \text{m}^3$$



-Note: When mixing two or more materials then:

$$m_{(mix)} = m_1 + m_2 + \dots$$

$$\therefore \rho V_{ol (mix)} = \rho_1 (V_{ol})_1 + \rho_2 (V_{ol})_2 + \dots$$

$$V_{ol (mix)} = (V_{ol})_1 + (V_{ol})_2 + \dots$$

$$\left(\frac{m}{\rho}\right)_{mix} = \frac{m_1}{\rho_1} + \frac{m_2}{\rho_2}$$

Factors that affect the density:

- 1-Atomic weight of the element or the molecular weight of the compound.
- 2-The distance between atoms or molecules.

G.R

1- Density is considered a characteristic property for the material.

➡ Because it changes by changing the type or the temperature of the material but not by changing its mass or volume.

2-Density of a material changes as the temperature changes.

➡ Because as the temperature changes the intermolecular distances change and so the density changes.

★Applications on Density:

➡ 1-Indicating how well the battery of the car is charged:

-Scientific idea

Measuring the density of the electrolyte solution inside it.

-Explanation: When the battery is discharged, the density of its electrolyte solution decreases and when the battery is recharged the density of electrolyte increases again.



G.R

-Density of the electrolyte solution decreases during discharging the battery.

➡ Due to the chemical reaction between the sulphuric acid and the lead plates and formation of lead sulphate.

2- Diagnosis of some diseases like (Anemia):

-Scientific idea ➡ Measuring blood density

G.R

Explanation: The normal density of the blood ranges from 1040 kg/m^3 to 1060 kg/m^3 , So if the blood density preceded 1040 kg/m^3 , This indicates decreases in the concentration of the red blood cells which indicates anemia.

3- Determining the concentration of salts in urine:

-Scientific idea ➡ Measuring the urine density.



G.R

-Some diseases can be diagnosed by measuring the density of urine.

➡ Because some diseases increase the ratio of salts in urine above the normal rate that increases its density.

★ The normal density of urine is 1020 kg/m^3 .

The relative density (specific weight)

It is the ratio between the density of the material to the density of water at the same temperature. **OR**

It is the ratio between the mass of a certain volume of a material to the mass of the same volume of water at the same temperature.

Relative density of a substance = $\frac{\text{density of the material at certain temperature}}{\text{density of water at the same temperature}}$

Relative density of a substance = $\frac{\text{mass of a certain volume of a material at certain temperature}}{\text{mass of the same volume of water at the same temperature}}$

$$\rho_r = \frac{\rho_{\text{material}}}{\rho_{\text{water}}} = \frac{m_{\text{material}}}{m_{\text{water}}}$$

$$\rho_{\text{material}} = \rho_{\text{relative}} \times \rho_{\text{water}} = \rho_{\text{relative}} \times$$

★G.R: Relative density has no measuring unit:

➡ Because it is a ratio between two similar quantities.

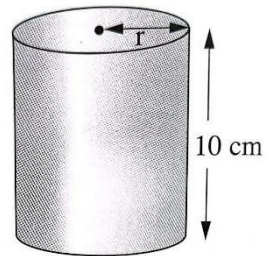
Class Sheet

1- A tank contains a quantity of gasoline that has a mass of 3450 kg and a volume of 5 m³, so the density of gasoline is.....

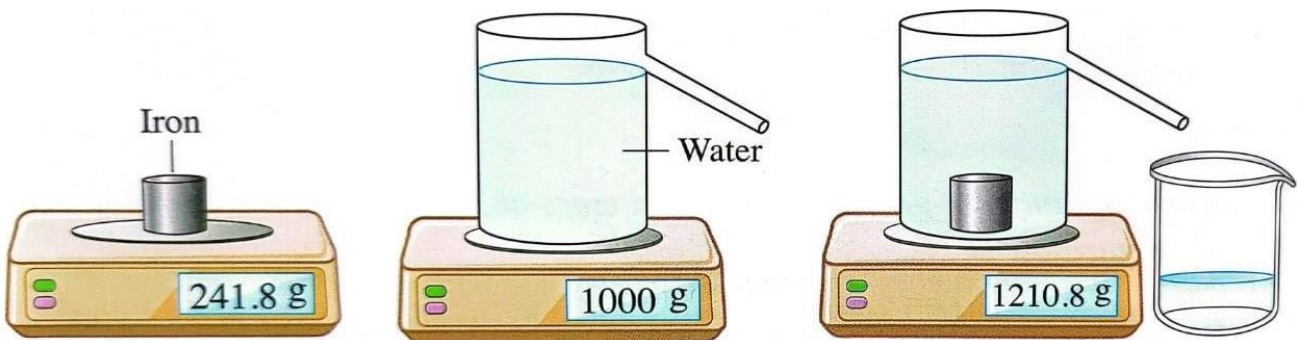
- a) 720 Kg/m³ b) 690 Kg/m³
c) 3.455 Kg/m³ d) 17.25 Kg/m³

2- The opposite figure represents a solid cylinder of mass 10 kg and height 10 cm made of a substance of density 8700 kg/m³, so the radius of the cylinder base approximately equals. (Given that: The volume of a cylinder = $\pi r^2 h$)

- a) 0.06 cm b) 4.5 cm
c) 6 cm d) 10.5 cm

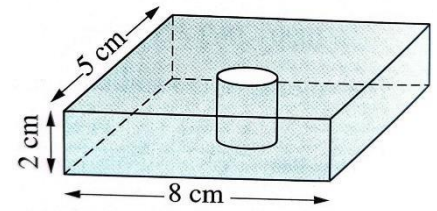


3- By using the following figures, the density of iron is..... (Given that: $\rho_{\text{water}} = 1000 \text{ kg/m}^3$)



- a) 7800 Kg/m³ b) 7900 Kg/m³
c) 8100 Kg/m³ d) 8300 Kg/m³

4- A cuboid of steel with a mass of 500 g and dimensions as shown in the opposite figure contains a cylindrical cavity of regular cross-section. If the density of the steel is 8 g/cm^3 then the cross-sectional area of the cavity equals.....



- a) 7.25 cm^2 b) 7.75 cm^2
c) 8.25 cm^2 d) 8.75 cm^2

5- 50 m^3 of water, whose density is 1000 kg/m^3 , was mixed with 40 m^3 of a liquid of density 800 kg/m^3 to make a solution whose total volume equals the sum of the volumes of the liquids before mixing. Then, the density of the solution approximately equals.....

- a) 1800 kg/m^3 b) 1128 kg/m^3
c) 911 kg/m^3 d) 8846 kg/m^3

6- Two metals x, y have densities ρ and 2ρ respectively, if two volumes of them are required to be mixed to form an alloy, which of the following ratios of the two volumes can be mixed to obtain an alloy with the largest density, ignoring the change in the total volume when forming the alloy?

	The volume of metal (x)	The volume of metal (y)
(a)	1	1
(b)	2	1
(c)	3	2
(d)	2	3

7- If the density of aluminum is 2700 kg/m^3 and the density of water at the same temperature is 10^3 kg/m^3 , then:

(i) The relative density of aluminum equals.....

- a) 0.27 b) 0.54
c) 2.7 d) 5.4

(ii) The mass of an aluminum piece of volume 0.1 m^3 equals.....

- a) 135 kg b) 270 kg
c) 540 kg d) 810 kg

8- A beaker is filled with 50 g of a liquid so that its mass with the liquid becomes 80 g. And after evacuating the beaker and refilling it with distilled water of density 1000 kg/m^3 , the mass of the beaker and water together becomes 60 g. Then, the density of the liquid is.....

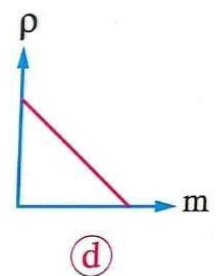
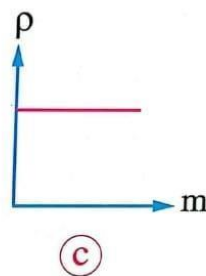
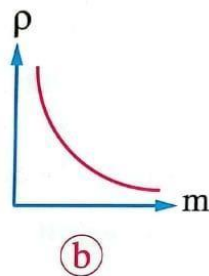
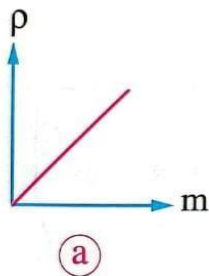
- a) 600 kg/m^3 b) 1260 kg/m^3
 c) 1667 kg/m^3 d) 2600 kg/m^3

Homework

1- From the units of measuring density.....

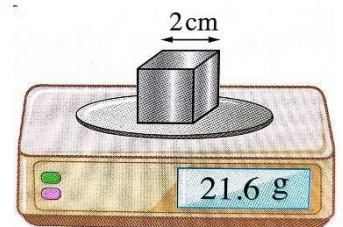
- a) N.m^{-3} b) g.mm^{-1}
 c) Kg.cm^{-2} d) g.cm^{-3}

2- The graph that represents the relation between the density of iron and the masses of solid iron pieces at constant temperature is.....



3- The opposite figure shows a solid cube of a certain material with a side length 2 cm placed on a scale so that it shows a reading of 21.6 g, then the density of the cube's material is equal to.....

- a) 2.7 g/cm^3 b) 3.6 g/cm^3
 c) 5.4 g/cm^3 d) 10.8 g/cm^3



4- The following table shows the specifications of two solid cubes A, B that are made of two different materials, then mass x equals.....

Cube	The length of the side (l)(m)	The density of the cube's material (ρ) (kg/m^3)	The mass (m) (kg)
A	0.01	ρ	0.008
B	0.02	2ρ	x

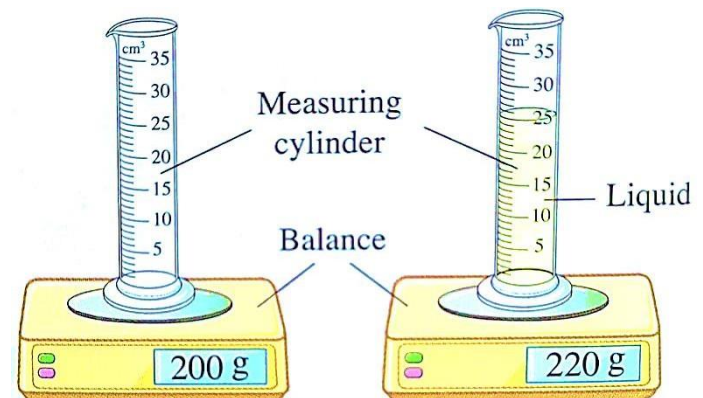
- a) 0.05 Kg b) 0.09 Kg
c) 0.128 Kg c) 0.145 Kg

5- A volume V_{ol} of a liquid of density ρ is poured into a vessel, if another quantity of the same liquid of volume $2 V_{ol}$ is added into the vessel, the density of the liquid becomes.....

- a) $\frac{1}{2}\rho$ b) ρ
c) $\frac{3}{2}\rho$ d) 2ρ

6- The diagram shows an experiment to find the density of a liquid, then the density of the liquid is.....

- a) 0.5 g/cm^3 b) 0.6 g/cm^3
c) 0.8 g/cm^3 d) 1 g/cm^3



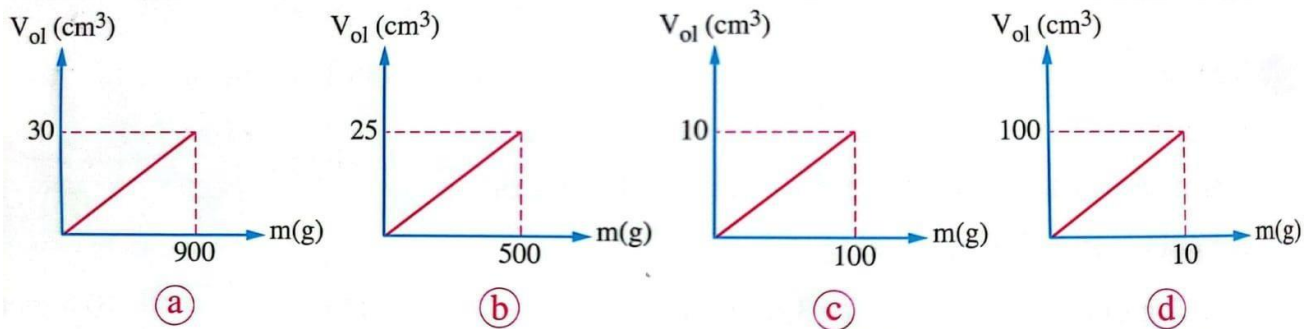
7- Two bodies (a, b) are made with equal masses of two different materials of densities 3 g/cm^3 and 4 g/cm^3 respectively, so the ratio between their volumes $\left(\frac{(v_{ol})_a}{(v_{ol})_b}\right)$ equals

- a) $\frac{1}{3}$ b) $\frac{4}{3}$
c) $\frac{3}{4}$ d) $\frac{1}{4}$

8- The ratio of the density of the electrolytic solution inside a car battery after discharging the battery to its density after recharging the battery is

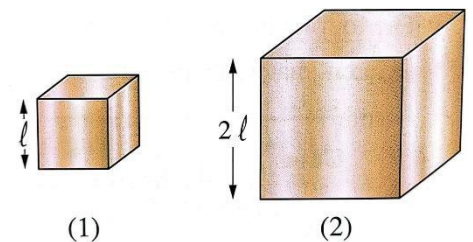
- a) greater than 1 b) equal to 1
- c) less than 1 d) indeterminable

9- Which of the following graphs represents the relation between the masses and the volumes of solid pieces of a metal of density 10^4 kg/m^3 ?



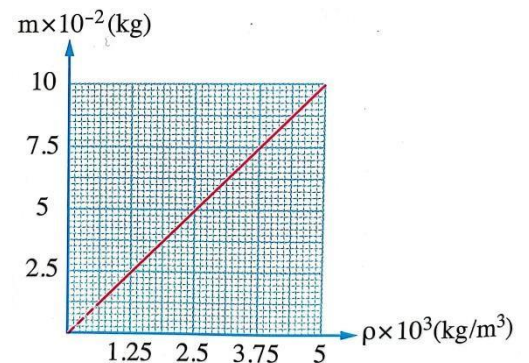
10- The opposite figure shows the dimensions of two solid cubes (1), (2) that are made of copper, if the weight of cube (1) is w , then the weight of cube (2) equals.....

- a) $2w$ b) $4w$
- c) $8w$ d) $16w$

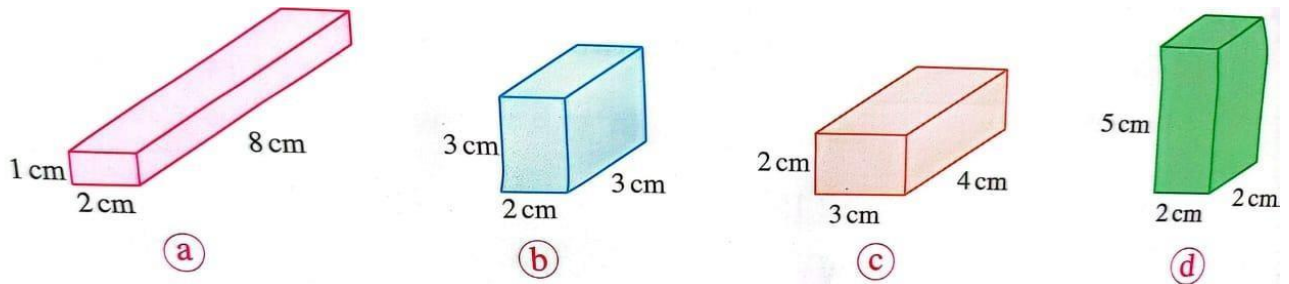


11- The opposite graph shows the relation between mass (m) and density (ρ) for equal volumes (V_{ol}) of different materials, so the value of this volume (V_{ol}) is.....

- a) 10 cm^3 b) 20 cm^3
- c) 30 cm^3 d) 40 cm^3



12- The following figures represent four solid bodies of different materials having equal masses, so which body has the least material density?



13- The following table shows the densities of some substances at the same temperature:

Substance	Mercury	Copper	Iron	Water	Kerosene
Density (g/cm ³)	13.6	8.9	7.9	1	0.87

Which of the following statements is correct?

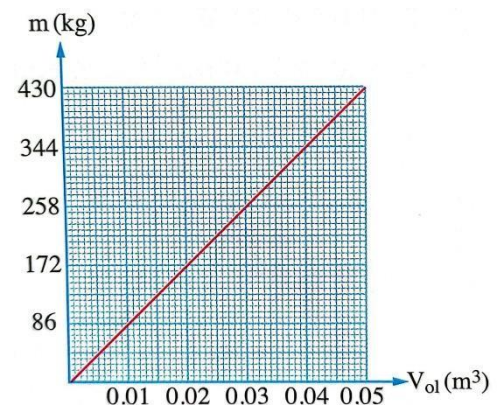
- a) Volume of 1 g of mercury is greater than the volume of 1 g of copper.
- b) Volume of 1 g of iron is less than the volume of 1 g of copper.
- c) Mass of 1 cm³ of mercury is greater than the mass of 1 cm³ of any other substance in the table.
- d) Mass of 1 cm³ of water is less than the mass of 1 cm³ of any other substance in the table.

14- Given that density of ice is X g/L and the density of water at 0°C is Y g/L, so the change a in the volume of a piece of ice of mass m when it melts at 0° C is

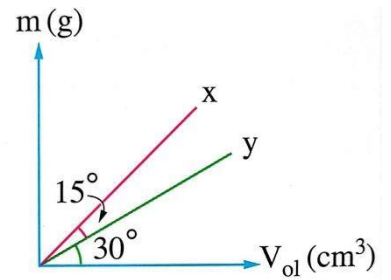
- a) $mY(X-Y)$
- b) $m(Y-X)$
- c) $m\left(\frac{1}{Y} - \frac{1}{X}\right)$
- d) $\frac{Y-X}{X}$

15- The opposite graph represents the relation tween mass (m) and volume (V_{ol}) for several pieces of copper, so the density of copper is.....

- a) 6800 kg/m³
- b) 7800 kg/m³
- c) 8600 kg/m³
- d) 8700 kg/m³

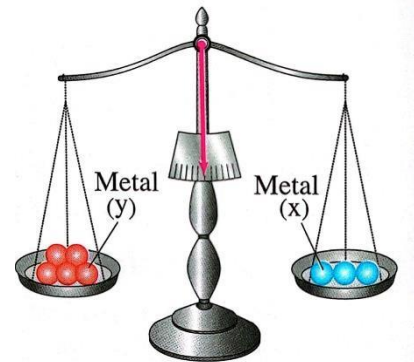


16- The opposite figure represents the graphical relation between mass (m) and volume (V_{ol}) for two materials x,y , then the ratio between the densities of the two materials ($\frac{\rho_x}{\rho_y}$) equals



- a) 0.46 b) 2.15
c) $\frac{1}{\sqrt{3}}$ d) $\sqrt{3}$

17- In the opposite figure, both groups of balls have the same mass where one group is made of metal (x) and the other group of metal (y). If all balls are solid and have equal volumes, the ratio between the densities of the two metals ($\frac{\rho_x}{\rho_y}$) is



- a) $\frac{3}{5}$ b) $\frac{5}{3}$
c) $\frac{1}{1}$ d) $\frac{8}{3}$

18- The opposite table shows some values of the density of water at different temperatures:

Temperature (°C)	Water density (kg/m ³)
3.98	1000
10	999.7
25	997.1
100	958.4

(i) At which temperature does a cubic meter of water have the greatest mass?

- a) 3.98 °C b) 10 °C
c) 25 °C d) 100 °C

(ii) At which temperature does one kilogram of water have the largest volume?

- a) 3.98°C b) 10°C
c) 25°C d) 100°C

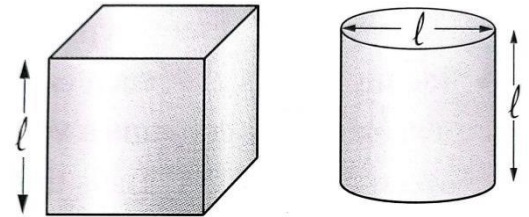
19- If the price of 1 g of gold is 1000 pounds, then the side length (l) of a solid cube made of gold of 1 million pound equals..... (Where: The density of gold is $19.3 \times 10^3 \text{ Kg/m}^3$)

- a) 0.01 cm b) 1 cm
c) 2 cm d) 3.7 cm

20- Two solid balls are made of different materials, the first has radius r and density ρ and the second has radius $2r$ and density 2ρ , so the ratio between their masses ($\frac{m_1}{m_2}$) equals.....

- a) $\frac{1}{2}$ b) $\frac{1}{4}$
c) $\frac{1}{8}$ d) $\frac{1}{16}$

21- The opposite figure shows a cube and a cylinder. If both are made of solid iron, the ratio between the mass of the cube to that of the cylinder ($\frac{m_{\text{cube}}}{m_{\text{cylinder}}}$) is.....



(Where: The volume of the cylinder = $\pi r^2 h$)

- a) $\frac{1}{\pi}$ b) $\frac{2}{\pi}$
c) $\frac{4}{\pi}$ d) 1

22- If the relative density of wood is 0.6, then: (Where: $\rho_w = 1000 \text{ kg/m}^3$)

(i) The density of wood equals.....

- a) 300 kg/m^3 b) 600 kg/m^3
c) 1200 kg/m^3 d) 1666.67 kg/m^3

(ii) The mass of a piece of wood of volume 0.1 m^3 is.....

- a) 30 kg b) 60 kg
c) 600 kg d) 1200 kg

23- A beaker has a mass of 230 g when it is empty. If its mass when it is filled with water is 700 g and when it is filled with oil is 600 g, then: (Given that: $\rho_w = 1000 \text{ kg/m}^3$)

(i) The relative density of oil equals.....

- a) 1.27 b) 1.25
c) 0.8 d) 0.787

(ii) The capacity of the beaker equals.....

- a) 470 cm^3 b) 500 cm^3
c) 2000 cm^3 d) 2128 cm^3

From the previous, a fluid can be defined as follows:

A fluid:

It is a material that can flow and has no definite shape. Like liquids and gases.



In this chapter, we will study only two of the properties of the moving fluids which are:

1- Flow

2- Viscosity

And in this lesson, we will study the flow of liquids in some detail.

Flow:

The flow of liquids are classified into two types:

a) Steady flow

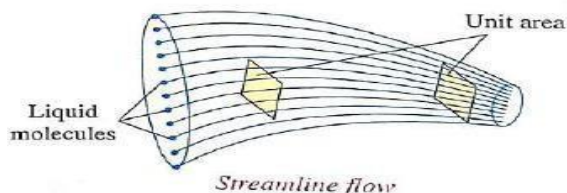
b) Viscosity

a) Steady flow

When a liquid moves such that its adjacent layers slide smoothly over each other, we describe this motion as a laminar flow or a streamline (steady) flow, where every small amount of the liquid follows a continuous imaginary path called streamline.

Characteristics of streamlines:

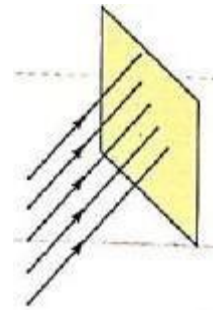
- 1) They are imaginary lines that do not intersect.
- 2) The number of streamlines at any cross-section of the tube is constant.
- 3) The direction of the instantaneous velocity (v) of a small amount of a liquid at a certain point along a streamline is determined by the tangent of that streamline at that point



4. The flow speed of a liquid at a point is determined by the density of streamlines at that point, so the speed of fluid flow increases by increasing the density of streamlines at that point and decreases by decreasing the density of streamlines.

Density of streamlines at a point:

It is estimated by the number of streamlines that pass Perpendicularly through a unit area surrounding that point.



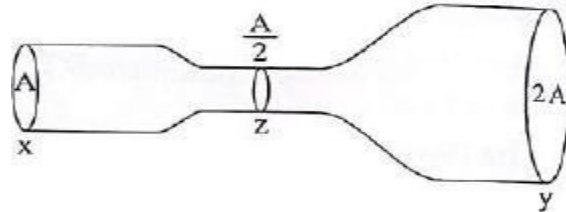
Conditions of steady flow :

1. The speed of the liquid at one given point along the path of the liquid remains constant and does not change as time passes.
2. The flow is irrotational ,i.e. there is no vortex motion.
3. No frictional forces exist between the layers of the liquid.
4. The flow rate of the liquid should be constant along its path because the liquid is incompressible and its density does not change with distance or time.
5. The liquid fills the tube completely such that the amount of liquid (volume and mass) that enters the tube at one end equals the amount of liquid that emerges from the other end in the same time interval according to the law of mass conservation.

Example 1:

The opposite figure shows a liquid flowing steadily in a tube from one terminal to the other, so the ratio of the numbers of streamlines through the cross-sections x:y:z is

- a) 2 : 1 : 4 b) 1 : 2 : 4
c) 2 : 4 : 1 d) 1 : 1 : 1



Solution

In the steady flow, the number of streamlines through any cross-section of the tube remains constant where the streamlines don't intersect.

So the correct choice is d)

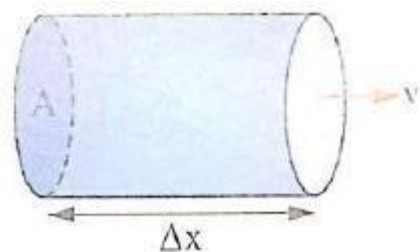
Density (ρ):

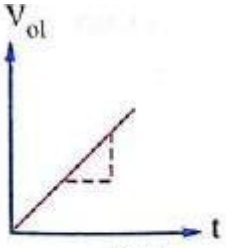
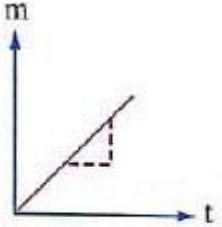
It is the mass of a unit volume of the material. It is measured in kg/m^3 and calculated from the relation:

$$\rho = \frac{m}{V_{\text{ol}}}$$

Flow rate

Consider a quantity of volume (V_{ol}) and mass (m) of a liquid of density(ρ) flowing through a cross-sectional area of a tube (A) at velocity (v), where it covers a distance Δx in time Δt as in the figure, then:



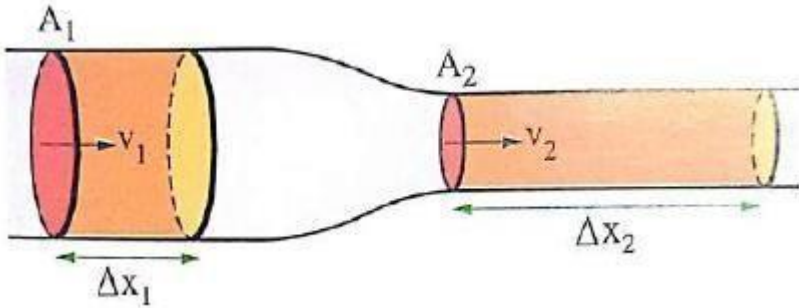
	Volume flow rate (Q_V)	Mass flow rate (Q_m)
Concept	The volume of liquid that flows steadily through a definite cross-section of a tube in one second.	The mass of liquid that flows steadily through a definite cross-section of a tube in one second.
Deducing the relation	$Vol = A * \Delta x$ $Q_V = \frac{Vol}{\Delta t} = A \frac{\Delta x}{\Delta t}$ $Q_V = A * v$	$m = \rho * Vol$ $m = \rho * A * \Delta x$ $Q_m = \frac{m}{\Delta t}$ $= \rho * A * \frac{\Delta x}{\Delta t}$ $Q_m = \rho * A * v$
	So $Q_m = \rho * Q_V$	
Measuring unit	m^3/s	kg/s
Graphical representation	 $\text{Slope} = \frac{\Delta V_{ol}}{\Delta t} = Q_V$	 $\text{Slope} = \frac{\Delta m}{\Delta t} = Q_m$

From the previous, we conclude that:

When the liquid flows steadily across a tube, the flow rate (volume or mass) will be constant at any cross-section of the tube.

Deducing continuity equation (the relation between the liquid flow speed and the cross - sectional are of the tube):

Assume two different cross-sections of a tube that contains a liquid of density(ρ), flowing steadily as in the following figure:

	
In the first cross-section (A1)	In the second cross-section (A2)
<u>The volume flow rate</u>	
$Q_V = A_1 * v_1$	$Q_V = A_2 * v_2$
<u>The mass flow rate</u>	
$Q_m = \rho * A_1 * v_1$	$Q_m = \rho * A_2 * v_2$

∴ The liquid flows steadily.

∴ The flow rate (volume or mass) is constant at any cross-section of the tube.

$$\therefore \rho * A_1 * v_1 = \rho * A_2 * v_2$$

$$\therefore A_1 * v_1 = A_2 * v_2$$

$$\therefore \frac{v_1}{v_2} = \frac{A_1}{A_2} \text{ this relation is called the continuity equation.}$$

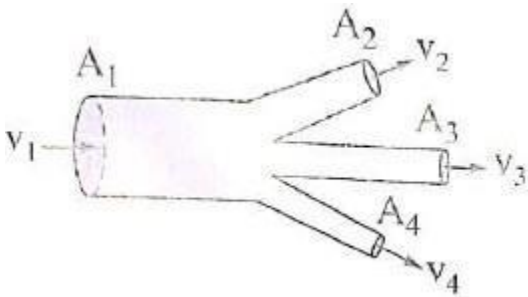
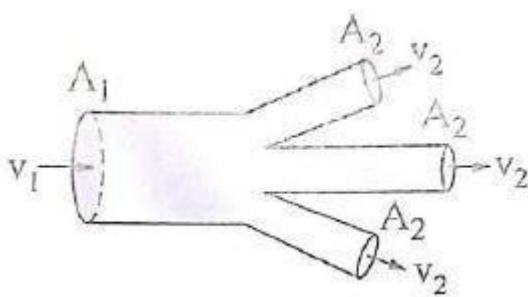
∴ $A = \pi r^2$, where r is the radius of the tube cross-section.

$$\therefore \frac{v_1}{v_2} = \frac{r_2^2}{r_1^2} = \frac{d_2^2}{d_1^2} \text{ where d is the diameter of the tube cross-section.}$$

From the previous, we can conclude that:

The speed of liquid that is flowing steadily in a tube at any point is inversely proportional to the cross-section area of the tube (as well as the square of the radius of the tube and also the square of its diameter) at that point.

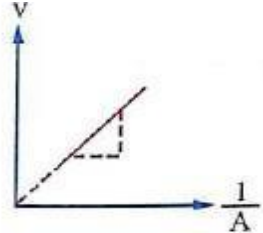
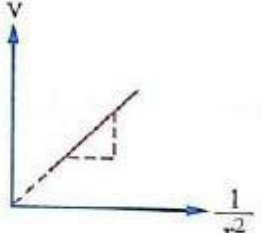
When the liquid flows steadily in a tube that branches into a number of branches of:

Different cross-sectional areas	The same cross-sectional area
	
Then	
$A_1 v_1 = A_2 v_2 + A_3 v_3 + A_4 v_4$	$A_1 v_1 = n A_2 v_2$ (where n is the number of branches)
$r_1^2 v_1 = r_2^2 v_2 + r_3^2 v_3 + r_4^2 v_4$	$r_1^2 v_1 = n r_2^2 v_2$
$d_1^2 v_1 = d_2^2 v_2 + d_3^2 v_3 + d_4^2 v_4$	$d_1^2 v_1 = n d_2^2 v_2$

Notes:

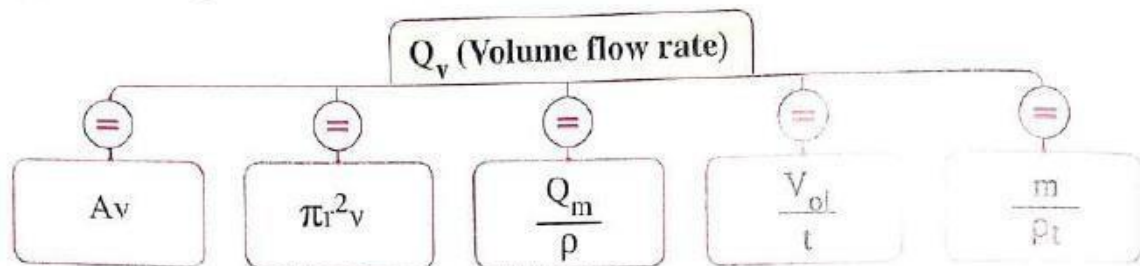
1) When a liquid flows steadily in a tube of non-uniform cross-sectional area, we can represent the graphical relation between:

- Velocity of the liquid (v) and reciprocal of the cross-sectional area ($\frac{1}{A}$)
- Velocity of the liquid (v) and reciprocal of square of the cross-sectional radius ($\frac{1}{r^2}$)

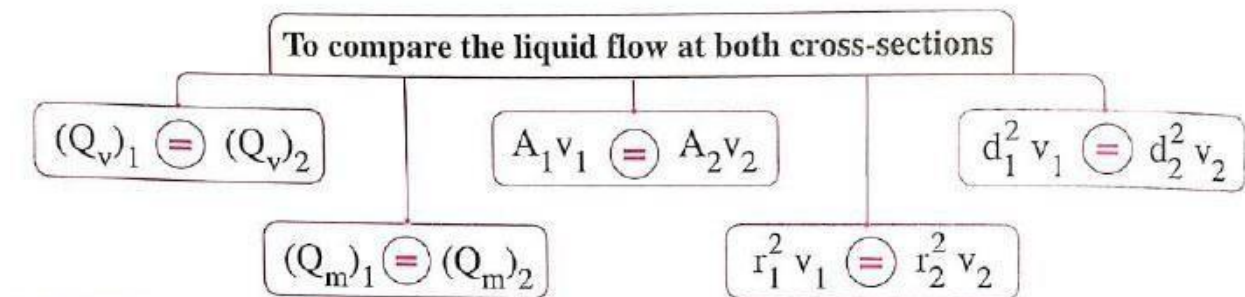
Velocity of the liquid (v) and reciprocal of the cross-sectional area ($\frac{1}{A}$)	Velocity of the liquid (v) and reciprocal of square of the cross-sectional radius ($\frac{1}{r^2}$)
 $\text{Slope} = \frac{\Delta v}{\Delta \left(\frac{1}{A}\right)} = Q_v$	 $\text{Slope} = \frac{\Delta v}{\Delta \left(\frac{1}{r^2}\right)} = \frac{Q_v}{\pi}$

2) When opening multiple taps together to fill a container with a liquid such that the flow rate of the liquid from each tap is $(Q_v)_1$, $(Q_v)_2$, $(Q_v)_3$, then the total flow rate (Q_v) of filling the container is calculated from the relation : $Q_v = (Q_v)_1 + (Q_v)_2 + (Q_v)_3$

(3) When a liquid flows steadily in a tube, then at any cross-section of the tube;



(4) When a liquid flows in a tube with two different cross-sectional area;



Example 1:

Water flows from a water tap in the rate of 0.5 kg/s, so the time required to fill a container of volume 2 m³ using this tap is.....

(Where $\rho_{\text{water}} = 1000 \text{ Kg/m}^3$)

- a) 10³ s b) 4x 10³ s c) 10⁴ s d) 4x 10⁴ s

Solution: $Q_m = 0.5 \text{ kg/s}$ $V_{ol} = 2 \text{ m}^3$ $\rho_{\text{water}} = 1000 \text{ Kg/m}^3$ $t = ??$

$$V_{ol} = Q_v t \quad \text{so} \quad t = \frac{V_{ol}}{Q_v} = \frac{V_{ol} * \rho}{Q_m} = \frac{2 \times 1000}{0.5} = 4 \times 10^3 \text{ s}$$

Example 2:

The opposite figure shows a water container of volume V_{ol} , which can be filled using two water taps x and y such that if only tap x is used, the container takes 15 minutes to be filled but if only tap y is used, the container takes 30 minutes to be filled, then the time required to fill the container by using the two taps x and y together is



- a) 5 minutes b) 10 minutes c) 15 minutes d) 20 minutes

Solution: $t_x = 15 \text{ minutes}$ $t_y = 30 \text{ minutes}$ $t = ???$

$$Q_v = Q_{vx} + Q_{vy} \quad , \quad Q_v = \frac{V_{ol}}{t}$$

$$\frac{V_{ol}}{t} = \frac{(V_{ol})_x}{t_x} + \frac{(V_{ol})_y}{t_y}$$

But the Volume (V_{ol}) of container is fixed.

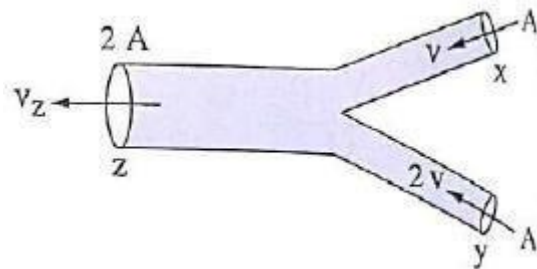
$$\frac{1}{t} = \frac{1}{t_x} + \frac{1}{t_y}$$

$$\frac{1}{t} = \frac{1}{15} + \frac{1}{30} = \frac{1}{10}$$

So $t = 10$ minutes

Example 3:

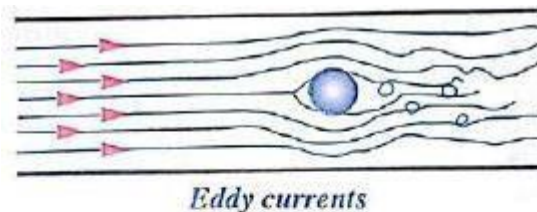
A liquid flow steadily in a tube as the opposite figure. If the cross-sectional area of x, y, z are A , A , $2A$ respectively and the liquid speeds at the cross-section x, y are v , $2v$ respectively, then the liquid speed at z equals



- A) $2v$ b) $\frac{2}{3}v$ c) $\frac{3}{2}v$ d) v

Turbulent Flow:

The flow of fluid becomes turbulent which is characterized by the presence of small eddy currents forming vortices as in the figure when:



Eddy currents

-The speed of the fluid exceeds a certain limit.

-A gas transfers from small space to a wider space or from high pressure to low pressure



Turbulent flow of the smoke

Exercise

Choose the correct answer:

1) In steady flow, when the cross-sectional area of the tube decreases, the density of streamlines

- a) increases
- b) decreases but doesn't reach zero
- c) vanishes
- d) remains unchanged

2) The number of streamlines of a liquid which passes perpendicularly through a unit area surrounding a certain point indicates

- a) the liquid speed at that point
- b) the volume flow rate
- c) the mass flow rate
- d) the liquid density

3) In the opposite figure, a liquid flow steadily in a tube, so the physical quantity which is greater at cross-section x than at cross-section y is

- a) the liquid speed
- b) the volume of the flowing liquid in unit time
- c) the mass of the flowing liquid in unit time
- d) the number of the streamlines through the cross-section

4) Water flows steadily in a tube of diameter 2 cm at a speed of 5 m/s. Thus;

(i) The volume of water which is flowing through the cross-section of the tube in one-minute equals (where $\pi=3.14$)

- a) 9.42 m^3
- b) 0.19 m^3
- c) 0.0942 m^3
- d) 0.001 m^3

(ii) The time required to fill a tank of volume 20 m^3 by using the flowing water from the tube is

- a) 127.38 minutes
- b) 212.31 minutes
- c) 3.54 minutes
- d) 2.123 minutes

5) A water pipe has cross-sectional area 4 cm^2 at the ground floor and 2 cm^2 at the upper floor. If water is flowing steadily inside the pipe such that its speed at the ground floor was 2 m/s , then:

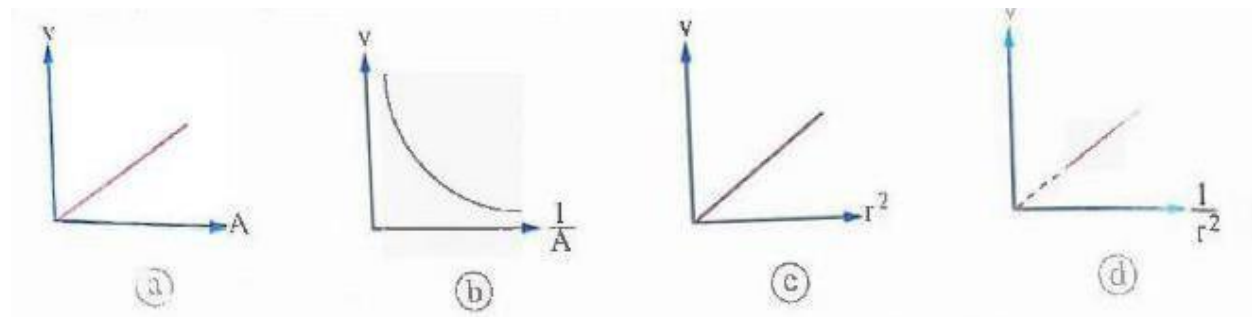
(Given that: Water density = 1000 kg/m^3)

- (i) The flow speed at the upper floor is
- a) 1 m/s b) 2 m/s c) 3 m/s d) 4 m/s
- (ii) The volume flow rate of water at the ground floor equals
- a) $4 \times 10^{-4} \text{ m}^3/\text{s}$ b) $6 \times 10^{-4} \text{ m}^3/\text{s}$ c) $8 \times 10^{-4} \text{ m}^3/\text{s}$ d) $12 \times 10^{-4} \text{ m}^3/\text{s}$
- (iii) The mass flow rate of water at the upper floor equals.....
- a) 1.2 kg/s b) 0.8 kg/s c) 0.6 kg/s d) 0.4 kg/s

6) Water is rushing through a pump opening of cross-sectional area 5 cm^2 at a speed of 12 m/s . The mass of water coming out from the pump within 30 minutes is..... (Given that: Density of water = 1000 kg/m^3)

a) $18.2 \times 10^3 \text{ kg}$ b) $15.1 \times 10^3 \text{ kg}$ c) $10.8 \times 10^3 \text{ kg}$ d) $8.6 \times 10^3 \text{ kg}$

7) The graph that represents the continuity equation for liquids flow is



8) Oil flows in a tube x at a rate of 6 liters/minute and gets out from another tube y which is connected to the first tube x at a speed of 4 m/s , then the cross-sectional area of the second tube y equals

a) $1.5 \times 10^{-3} \text{ m}^2$ b) 1.5 m^2 c) $2.5 \times 10^{-5} \text{ m}^2$ d) 0.025 m^2

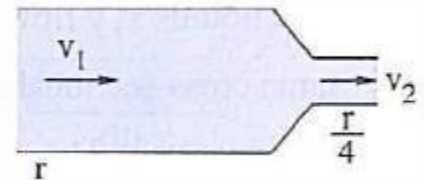
9) If the cross-section of a tube has increased to the double in steady flow, then the flow speed

- a) gets doubled b) decreases to half its value
c) gets quadrupled d) remains constant

10) If the ratio between the radii of two cross-sections of a tube in steady flow is $\frac{1}{2}$ then the ratio between the speeds of the liquid through them respectively is

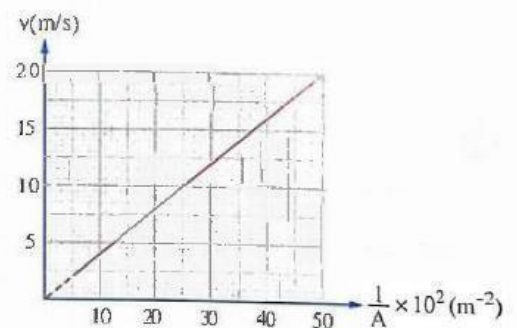
- a) $\frac{1}{4}$ b) $\frac{1}{2}$ c) $\frac{2}{1}$ d) $\frac{4}{1}$

11) A liquid flows steadily in a tube that tapers from radius r at one end to radius $\frac{r}{4}$ at the second end as in the opposite figure, then the ratio between the speed of the liquid in the first cross-section of the tube and its speed in the second cross-section of the tube equals.....



- a) $\frac{1}{4}$ b) $\frac{1}{16}$ c) $\frac{16}{1}$ d) $\frac{4}{1}$

12) The opposite graph illustrates the relation between the liquid flow speed (v) at a point in a tube and the reciprocal of the cross-sectional area of the tube ($\frac{1}{A}$) at that point, then:



(i) The volume flow rate equals

- a) $40\text{m}^3/\text{s}$ b) $4\text{m}^3/\text{s}$
c) $0.4\text{m}^3/\text{s}$ d) $0.004\text{m}^3/\text{s}$

(ii) The mass of the flowing liquid within 30 minutes if the liquid density is 1000 kg/m^3 equals

- a) 120 kg b) 1200 kg c) 7200 kg d) $7.2 \times 10^5\text{ kg}$

13) An oil pump pumps 1.2m^3 of oil within 60s in a cylindrical tank of diameter 4m and height 3m. If the oil density is 820 kg/m^3 , then:

(i) The mass flow rate of the oil from the pump opening equals

- a) 0.02kg/s b) 5.2kg/s c) 16.4kg/s d) 18.4kg/s

(ii) The time required to fill the tank with oil is

- a) 27.21 minutes b) 31.43 minutes
c) 42.43 minutes d) 51.54 minutes

Viscosity:

It is the property that causes a resistance or a friction between the liquid layers preventing them from sliding smoothly above each other.

The higher viscous liquid:

1. Shows higher resistance to its own motion and its flow.
2. Shows higher resistance to the motion of bodies through it.

Explaining the concept of viscosity:

There are two types of attraction forces between the molecules of matter:

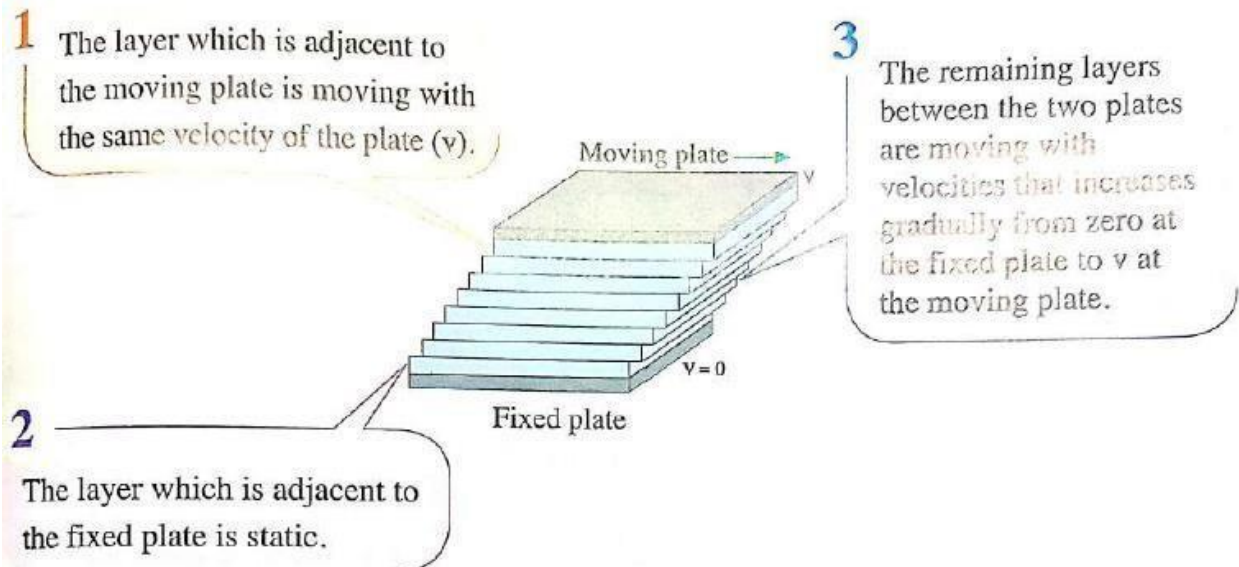
1 Cohesive forces:

Attraction forces between the molecules of the same substance like the attraction forces between the honey molecules.

2 Adhesive forces:

Attraction forces between the molecules of a substance and the molecules of another substance like the adhesive forces between the molecules of a drop of water and glass.

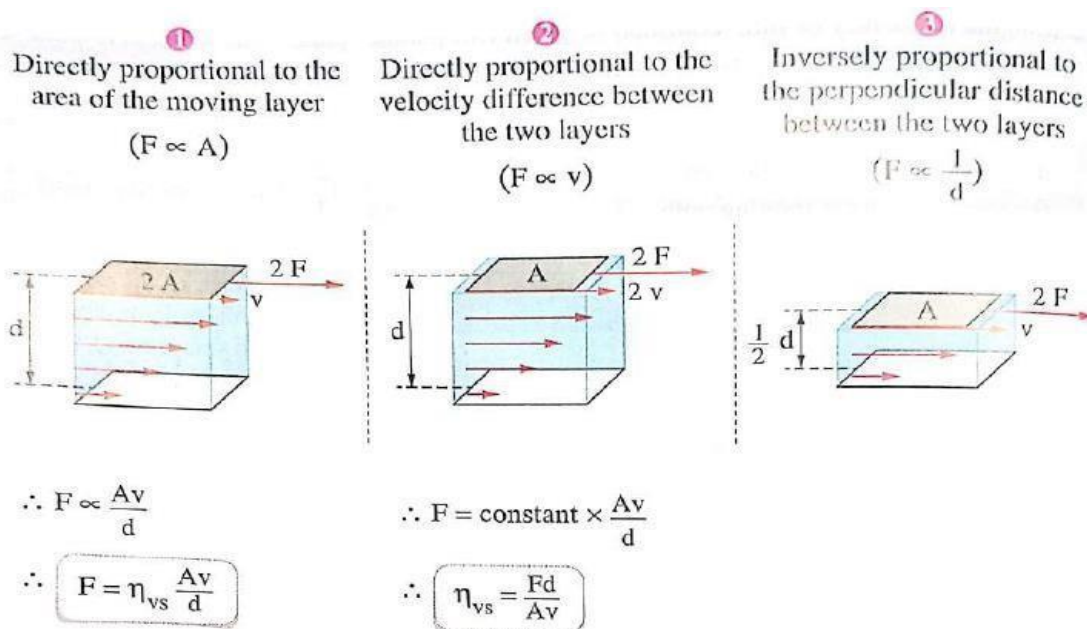
Imagine a quantity of a fluid confined between two parallel plates, one of them is static and the other moves with velocity (v) as shown in the figure.



This happens due to:

1. The presence of friction between each plate and the adjacent layer of liquid that results from the adhesive forces between the molecules of the solid plate and the molecules of the adjacent liquid layer, so the speed of every layer is equal to that of its adjacent plate.
2. The existence of another force between each liquid layer and the layer below it which resists the sliding of the liquid layers above each other causing a relative change in velocity between each layer and the adjacent layer.

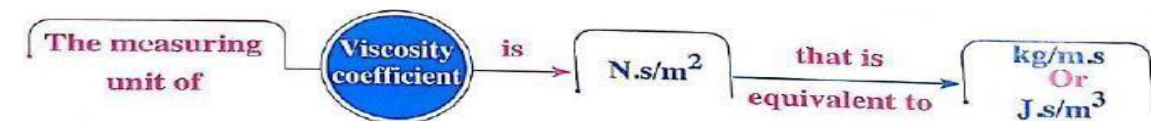
This type of flow is called the laminar flow or viscous flow



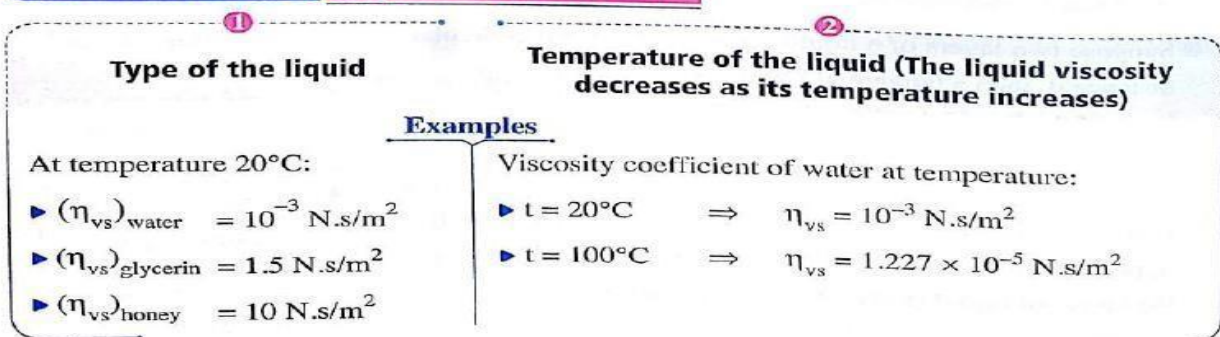
Where: η_{vs} is the viscosity coefficient that can be defined as:

Viscosity coefficient (η_{vs}):

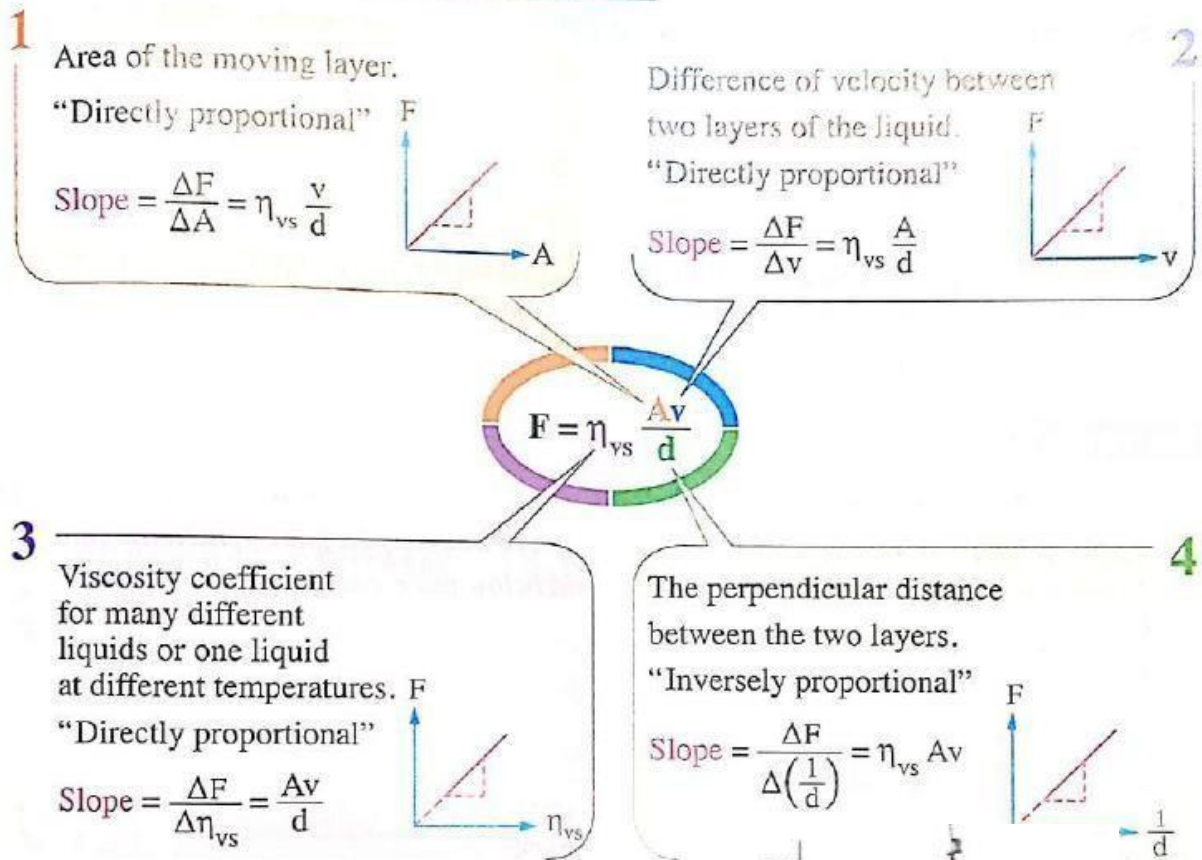
It equals numerically the tangential force that acts upon a unit area of a liquid causing a velocity difference of one unit between two layers separated by a perpendicular distance of one unit.



The factors affecting the viscosity coefficient :



The factors affecting the force of viscosity :



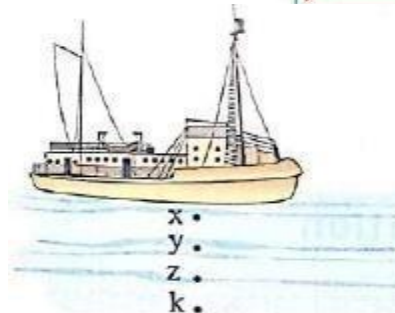
Example 1:

In the opposite figure a ship moves in a still water lake, so the water speed is less at point.....

- a) x

b) y
- c) z

d) k



Example 2:

A plane surface of area 0.5 m^2 moves at a uniform velocity of 2 m/s parallel to another static surface that is separated from it by a layer of liquid of thickness 4 cm , if the viscosity coefficient of the liquid is 15 kg/m.s , then the force required to keep the surface moving with this uniform velocity is

- a) 37.5 N

b) 50 N

c) 67.5 N

d) 150 N

Application of viscosity:

1- Lubrication of machines.

Machines should be lubricated from time to time to decrease the heat produced due to friction and to protect the machine parts from corrosion and increase its efficiency.

Highly viscous oils are used due to their strong adhesive forces with the machine parts, since they do not seep away or sputter from the machine parts during motion



Note:

Water cannot be used in lubrication because it has low viscosity, so it seeps away from the machine parts due to the weak adhesive force with the machine parts.

2-Saving fuel consumption in moving vehicles:

- The rate of fuel consuming in a moving vehicle depends on:
 1. Motion of the vehicle with an acceleration (changing velocity).
 2. Friction forces with:
 - The road.
 - Air (air resistance to the motion of the vehicle).



When the vehicle moves in a uniform velocity (acceleration= zero), so if this velocity is:

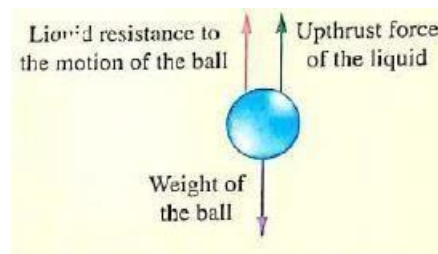
Low or medium	Higher than a certain limit

So, the expert driver of the vehicle limits the vehicle speed to reduce fuel consumption.

3In medicine, blood precipitation rate test (the terminal velocity of falling of the red blood cells in plasma)

When a ball falls freely in a liquid, it is affected by three forces:

- Its weight.
- Buoyancy (up thrust force) of the liquid.
- Friction between the ball and the liquid due to viscosity.



So, the velocity of the ball increases gradually till it attains a constant terminal velocity due to the balance of these three forces. The terminal velocity increases as the radius of the ball increases, so it can be determined if the volume of the red blood cells was normal or not by taking a blood sample and measuring its precipitation rate which is proportional to the terminal velocity of the falling red blood cells in the plasma, **for example:**

When	
The precipitation rate is greater than normal	The precipitation rate is lower than normal
it indicates that	
Red blood cells adhere together, so their volume and radius increase.	Red blood cells break down, so their volume and radius decrease.
so the terminal velocity of blood cells	
becomes higher	becomes lower
Like the case of	
Rheumatic fever	Anemia

Exercise

Choose the correct answer:

1) When a metallic ball falls through a fluid in a jar, the viscosity force of the liquid which is acting on the ball depends on

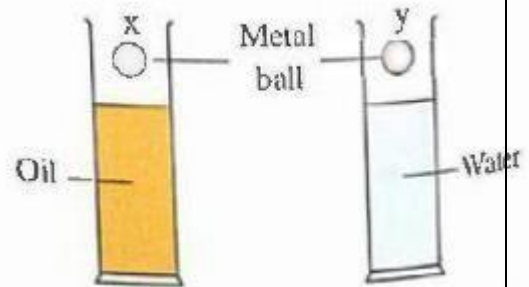
- a) the ball radius
- b) the liquid density
- c) the ball mass
- d) the liquid quantity

2) If the speed difference between two liquid layers gets decreased when a tangential force is acting on the upper layer, then at the same temperature the viscosity coefficient

- a) vanishes
- b) decreases but doesn't vanish
- c) increases
- d) remains constant

3) The opposite figure shows two identical metal balls (x, y) falling from the same height into two identical jars containing similar volumes of oil and water till reaching the bottoms, then the average speed of ball x is.....

- a) greater than the average speed of ball y
- b) less than the average speed of ball y
- c) equal to the average speed of ball y
- d) equal to its instantaneous speed at the bottom of the jar



4) A metallic ball has fallen once through water and another time through honey, if the average frictional force between the ball and the water is F_1 and between the ball and the honey is F_2 then which of the following statements for F_1 and F_2 is correct?

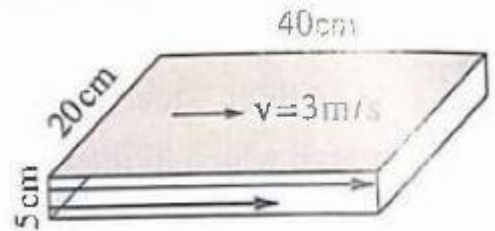
- a) $F_1 = F_2 = 0$
- b) $F_1 = F_2 \neq 0$
- c) $F_1 > F_2$
- d) $F_1 < F_2$

5) At relatively low or medium speeds of a car, the air resistance due to air viscosity is

- a) directly proportional to the square of the speed of the car
- b) directly proportional to the speed of the car
- c) inversely proportional to the square of the speed of the car
- d) inversely proportional to the speed of the car

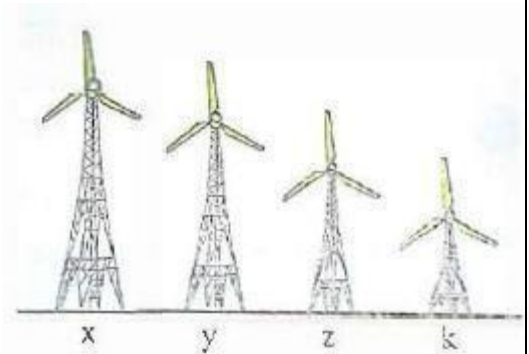
6) In the opposite figure, if a tangential force of 10 N acted upon the upper plate to move it at a uniform speed of 3 m/s, then the viscosity coefficient of the liquid equals

- a) 0.021 N.s/m^2
- b) 0.48 N.s/m^2
- c) 0.75 N.s/m^2
- d) 2.08 N.s/m^2



7) The opposite figure shows four windmills of identical turbines and blades installed near each other at different heights to be used for generating electricity, so the windmill that has the greater potential of generating electricity will be

- a) x
- b) y
- c) z
- d) k



8) A rectangular plate of dimensions 50 cm, 25 cm is affected by a tangential force of 15 N which moves it at a constant speed of 0.8 m/s on a layer of viscous liquid of thickness 9.375 mm, so the viscosity coefficient of the liquid is

- a) 0.42 kg/m.s
- b) 0.85 kg/m.s
- c) 1.41 kg/m.s
- d) 2.31 kg/m.s

Chapter 5 : Properties of Hydrostatics

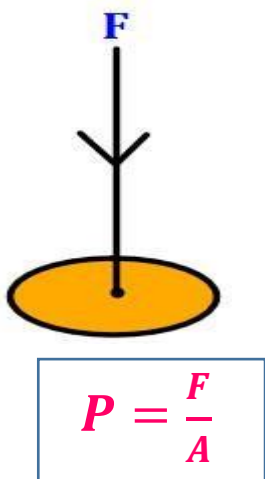
Pressure

It is the average force acting perpendicularly on a unit area surrounding this point.

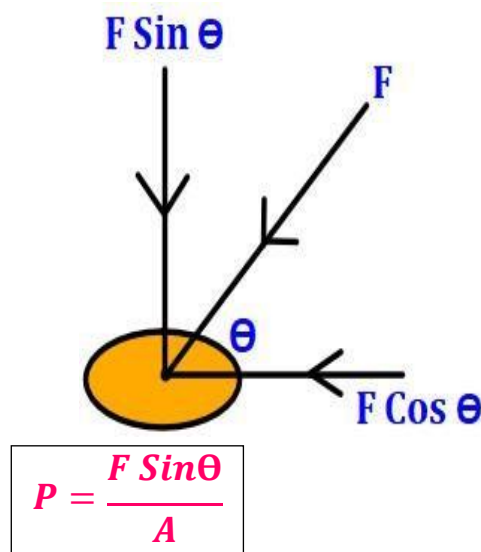
★ Finding pressure at a point:

-When the force:

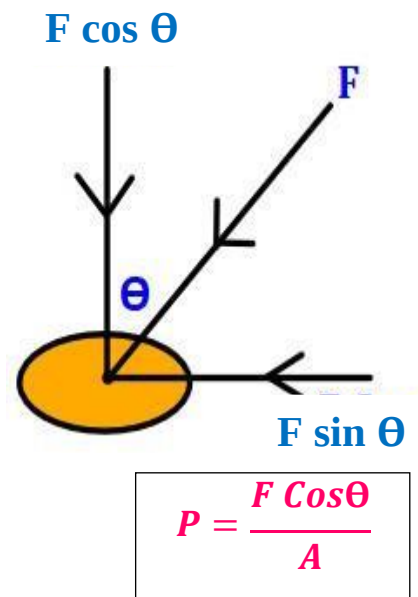
(a) perpendicular
To the surface.



(b) making an angle (θ)
with the surface.



(c) making an angle
(θ) with the normal



★ The measuring unit of pressure is:

1- (N/m^2)

2- (Pascal)

3- (kg/m.s^2)

4- (J/m^3)

5- (Bar)

6- (Torr)

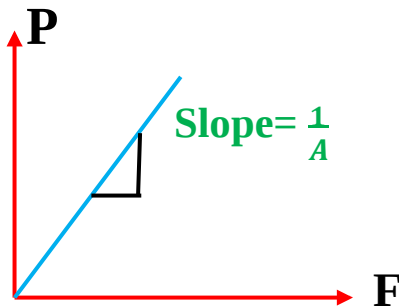
7- (m Hg)

8- (atm.)

★ Factors affecting the pressure at a point:

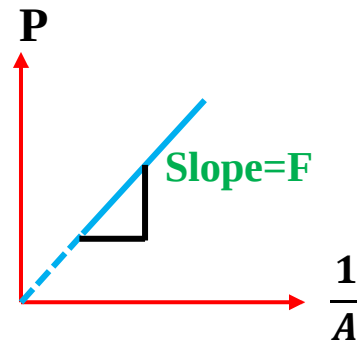
a) The average force acting Perpendicularly (F):

-Directly proportional.



b) Area surrounding the point.

-Inversely proportional.



$$\frac{P_1}{P_2} = \frac{F_1}{F_2} \times \frac{A_2}{A_1}$$

★ G.R: Tires of heavy trucks are wide.

➡ Because ($P \propto \frac{1}{A}$) so by increasing the area the pressure due to the weight of the car on the road decreases. So, the tires do not sink in sand roads.



★ G.R: The sewing needle has a very sharp tip:

➡ Because ($P \propto \frac{1}{A}$) so when the tip is very sharp very high pressure is produced and the needle penetrates the cloth easily.



★ Applications on the pressure:

1-Measuring blood pressure:

-Normal person has two values for blood pressure:

(A) Systolic pressure (contracting)

(B) The diastolic (relaxing)



(A) Systolic pressure (contracting)

It is the maximum value for the blood pressure when the heart muscle contracts and equal 120 Torr for the normal person.

(B) The diastolic (relaxing)

It is the minimum value for blood pressure when the heart muscles relaxes and equal 80 Torr for the normal person.

2-Measuring the air pressure inside the tires of a car:

★G.R: The tyre of the car is filled with air under a suitable high pressure:

➡ **To decrease the tangent area between the tire and the road, so the friction between them decreases and so on the temperature produced due to the friction decreases.**



Examples

1- A force of 25 N acted on a surface of area 5 cm², then the pressure affecting the surface if:

(i) The force was perpendicular to the surface equals.....

- a) $2.5 \times 10^4 \text{ N/m}^2$
- b) $3 \times 10^4 \text{ N/m}^2$
- c) $4.33 \times 10^4 \text{ N/m}^2$
- d) $5 \times 10^4 \text{ N/m}^2$

(ii) The force was making an angle of 60° with the surface equals.....

- a) $2.5 \times 10^4 \text{ N/m}^2$
- b) $3 \times 10^4 \text{ N/m}^2$
- c) $4.33 \times 10^4 \text{ N/m}^2$
- d) $5 \times 10^4 \text{ N/m}^2$

(Where: $g = 10 \text{ m/s}^2$)

a) 10^2 N/m^2 b) 10^3 N/m^2
c) 10^4 N/m^2 d) 10^6 N/m^2

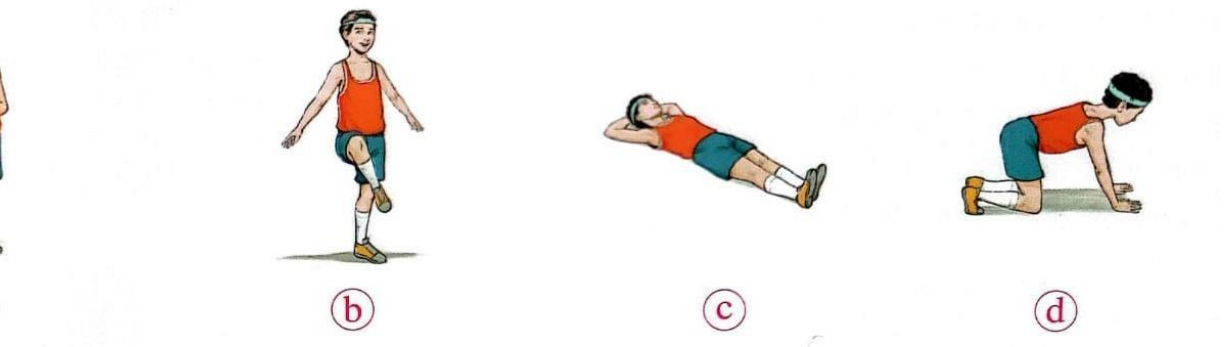


a) $2.5 \times 10^5 \text{ N/m}^2$ b) $0.25 \times 10^4 \text{ N/m}^2$
c) $2.25 \times 10^2 \text{ N/m}^2$ d) 0.25 N/m^2

a) $3.675 \times 10^5 \text{ Pa}$ b) $7.88 \times 10^5 \text{ Pa}$ **(Where: $g = 9.8 \text{ m/s}^2$)**
c) $1.47 \times 10^6 \text{ Pa}$ d) $2.94 \times 10^6 \text{ Pa}$

a) $7.5 \times 10^4 \text{ N/m}^2$ b) $2.5 \times 10^5 \text{ N/m}^2$
c) $5 \times 10^5 \text{ N/m}^2$ d) 10^6 N/m^2

a) Kg s^{-2} b) $\text{Kg.m}^{-1}.\text{s}^{-2}$
c) N.m^{-1} d) N.m^2



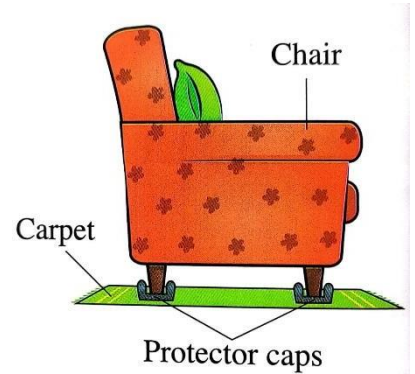
(8)

- 9 7 9

9 1 9 1

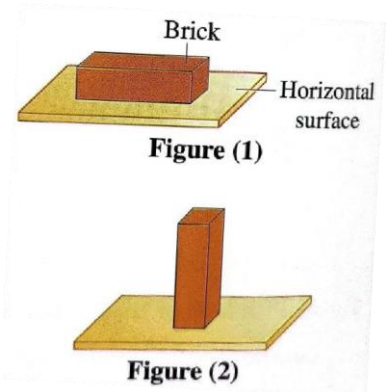
- $\Delta_{\text{max}} = 0,0000$

6- The opposite figure shows a chair whose legs are put in protector caps to protect the carpet under the chair, which of the following choices represents the effect of putting the caps on the area of contact between the legs and the carpet and the pressure on that area?



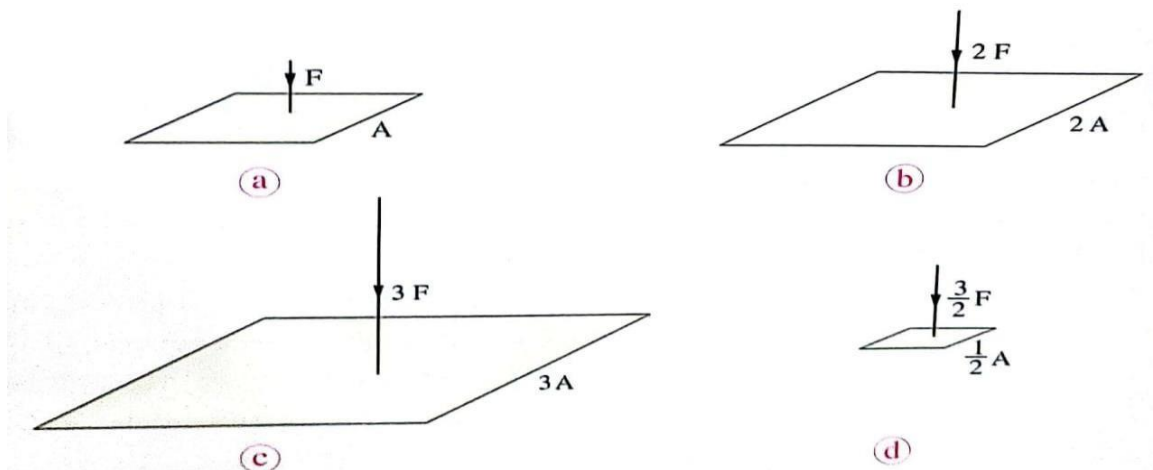
	Area of contact	Pressure
(a)	Decreases	Decreases
(b)	Decreases	Increases
(c)	Increases	Decreases
(d)	Increases	Increases

7- A brick is placed horizontally on a horizontal surface as in figure (1), if its orientation is changed to be as in figure (2), which of the following choices represents the effect of this change on each of the force and the pressure due to the brick on the contact surface?

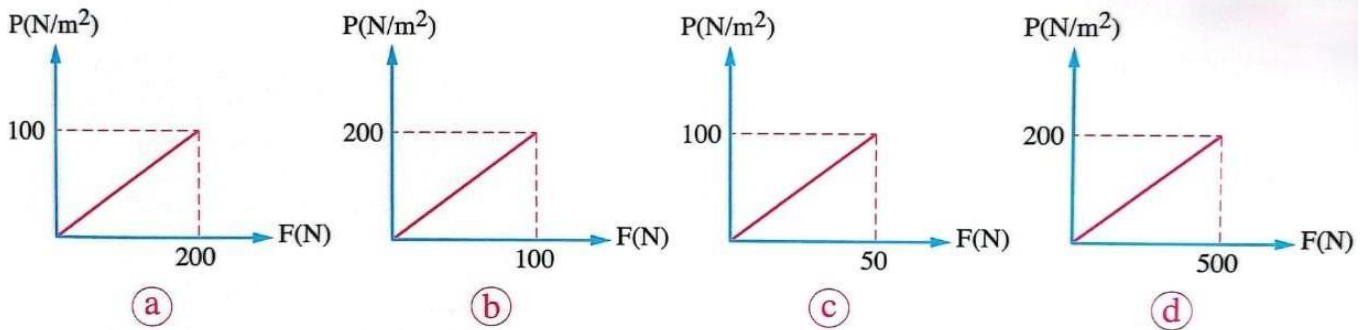


	The force	The Pressure
(a)	Increases	Decreases
(b)	Increases	Remains constant
(c)	Remains constant	Increases
(d)	Remains constant	Remains constant

8- Plane surfaces have different areas, each of them is affected by a different force as shown in the following figures, so in which figure the pressure exerted on the surface is the greatest?



Which of the following graphs represents the relation between the pressure (P) acting on a surface of area 2 m^2 and the force (F) causing that pressure?



10- A submarine has a circular window whose diameter is 0.3 m. If the maximum external pressure that the window can withstand is 660 kPa, so the minimum external force that can break the window is approximately equal to.....

- a) $40 \times 10^3 \text{ N}$ b) $47 \times 10^3 \text{ N}$
c) $40 \times 10^3 \text{ N}$ b) $120 \times 10^3 \text{ N}$

11- A man of weight w is standing on the ground with both of his feet. If the contact area of each foot with the ground is A , the man affects the ground with a pressure that equals

- a) $\frac{2W}{A}$ b) $\frac{W}{A}$
c) $\frac{W}{2A}$ b) $\frac{W}{4A}$

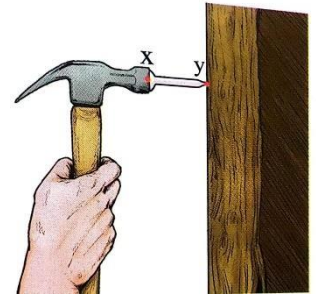
12- A cube of side length 10 cm and a cuboid made of the same material whose dimensions are 30 cm, 20 cm and 10 cm are placed on a horizontal surface. The face on which the cuboid can be placed on the surface to produce a pressure equal to the pressure produced by the cube is the face of dimensions.....

- a) $20\text{ cm} \times 10\text{ cm}$ b) $30\text{ cm} \times 10\text{ cm}$
c) $30\text{ cm} \times 20\text{ cm}$ d) the pressure produced by both cannot be equal

13- A solid alloy that is in the form of a cuboid is placed on a horizontal surface where the vertical dimension is 80 cm, if the pressure of the cuboid on the surface is 15200 Pa. then the density of the alloy equals (Take: $g = 10 \text{ m/s}^2$)

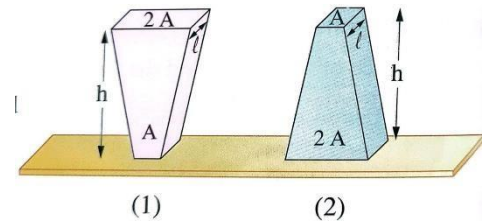
- a) 1800 kg/m³ b) 1900 kg/m³
c) 2000 kg/m³ d) 2200 kg/m³

14- The opposite figure shows a hammer exerting a force F on a nail that in turn exerts the same force on a piece of wood, so the ratio between the two quantities of pressures at the two points x and y ($\frac{P_x}{P_y}$) is



- a) greater than one b) less than one
c) equal to one d) we can't determine the answer

15- Two solid bodies that are made of two different metals are placed on a horizontal surface as shown in the figure, if the resulted pressures due to them are equal ($P_1 = P_2$) then the ratio between the densities of the two bodies equals

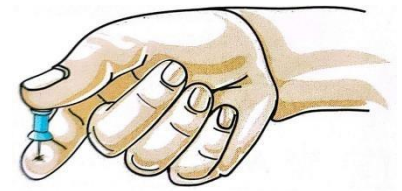


- a) $\frac{1}{1}$ b) $\frac{1}{2}$
c) $\frac{2}{1}$ d) $\frac{4}{1}$

16- A man sits on a chair of four legs while his feet don't touch the ground, so if the mass of both the man and the chair together is 95 kg and the legs of the chair have circular ends, each of radius 0.5 cm, then the pressure that each leg produces on the ground equals.....

- a) 2.96×10^6 Pa b) 5.92×10^6 Pa (Take: $g = 10 \text{ m/s}^2$)
c) 11.85×10^6 Pa b) 14.81×10^6 Pa

17- In the opposite figure a man holds a drawing pin between his thumb and index fingers where he presses on the head of the pin with his thumb by a force of 0.5 N without letting the tip injure him. If the area of the head of the pin is $6 \times 10^{-5} \text{ m}^2$ then:



(i) The force of the tip of the pin on the index equals.....

- a) 0.5 N b) 1 N
a) 2 N b) 4 N

(i) The pressure due to the head of the pin on the thumb finger is approximately equal to

- a) $4 \times 10^3 \text{ N/m}^2$ b) $8 \times 10^3 \text{ N/m}^2$
c) $9 \times 10^3 \text{ N/m}^2$ d) $12 \times 10^3 \text{ N/m}^2$

18- A student has put 8 coins above each other on a horizontal surface as shown in figure (1). If the weight of each coin is 0.08 N and the area of its face is $53 \times 10^{-4} \text{ m}^2$ then:



Figure (1)

(i) The pressure of these coins which acted on the surface equals

- a) $1.21 \times 10^3 \text{ N/m}^2$ b) $2.41 \times 10^3 \text{ N/m}^2$
c) $5.71 \times 10^3 \text{ N/m}^2$ d) $6.21 \times 10^3 \text{ N/m}^2$

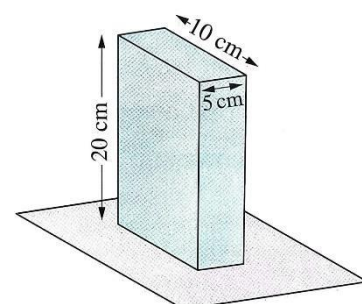
(ii) If the student spreads the coins on the surface as shown in figure (2), then:



Figure (2)

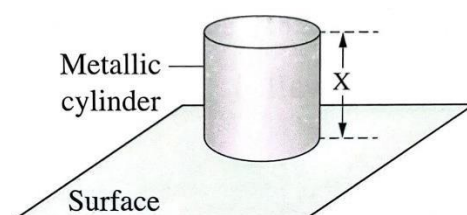
	The total force by which the coins act on the surface	The total pressure by which the coins affect the surface
(a)	Remains constant	Increases
(b)	Remains constant	Decreases
(c)	Decreases	Increases
(d)	Decreases	Doesn't change

19- In the opposite figure, a cuboid is placed on a horizontal surface such that the dimensions of its base are $(10 \text{ cm} \times 5 \text{ cm})$, so it exerts a pressure of value P on the surface, then how will the pressure on the surface change when the cuboid is repositioned to be on the base of dimensions $(20 \text{ cm} \times 10 \text{ cm})$?



- a) Increases by $\frac{P}{4}$ b) Decreases by $\frac{3P}{4}$
c) Increases by $4 P$ d) Decreases by $\frac{P}{2}$

20- The opposite figure represents a solid metallic cylinder of height X and cross-sectional area A placed on a horizontal surface. If the cylinder affects the surface by pressure P , the density of the material of the cylinder equals (Given that the acceleration due to gravity is g)



- a) $\frac{gX}{P}$ b) $\frac{P}{gX}$
c) $\frac{gX}{PA}$ d) $\frac{PA}{gX}$

كيفية طباعة صفحات معينة من ملف معين مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9

